SEP 9 1927

With METALLURGICAL SUPPLEMENT.

The Engineer.

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VOL. CXLIV.—No. 3737] LONDON: FRIDAY EVENING, AUGUST 26, 1927 [PRICE { WITH SUPPLEMENT } ONE SHILLING BY INLAND POST 1s. 3d.

PUBLIC NOTICES

TO BUILDERS.

The Commissioners of His Majesty's Works, &c., are prepared to receive TENDERS before 11 a.m. on Friday, 9th September, 1927, for the INSTALLATION of HEATING APPARATUS at Colchester Telephone Exchange.

The specification and a copy of the conditions and form of contract, bills of quantities and forms for Tender may be obtained from the CONTRACTS BRANCH, H.M. Office of Works, King Charles-street, London, S.W. 1, on payment of One Guinea. (Cheques payable to the Commissioners, H.M. Office of Works.) The sums so paid will be returned to those persons who send in Tenders in conformity with the conditions. 6327

The Director-General, India Store Department, Branch No. 15, Belvedere-road, Lambeth, S.E. 1, invites TENDERS for :—

1. 18,527 STEEL SOLID-DRAWN BOILER TUBES.
2. 1390 STEEL TYRES for ROLLING STOCK.
3. 1200 PAIRS CHILLED CAST IRON WHEELS for ROLLING STOCK.
4. 80 PAIRS WHEELS and AXLES.
5. 24 TANK WAGONS.
6. ONE 2-TON ELECTRIC TRAVELLING CRANE.

Tenders due on the 9th September, 1927, for Nos. 1 and 2, on the 13th September, 1927, for Nos. 3 and 4, and on the 16th September, 1927, for Nos. 5 and 6.

Specifications and forms of Tender obtainable from the above at a fee of 5s. per set, which will not be returned. 6341

Assistant Engineer for the PUBLIC WORKS DEPARTMENT DRAWING-OFFICE required by the GOVERNMENT of BRITISH GUIANA for two years' service with possible permanency. Salary £350, rising to £400 a year by annual increments of £25. Free passages. Candidates, unmarried, about 23 years of age, should have passed Sections A and B of the A.M.I.C.E. Examination or hold equivalent professional qualifications, and be neat and expeditious draughtsmen.—Apply at once by letter, stating age, qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1, quoting M/15362. 6345

Assistant Engineers (2) REQUIRED for the NIGERIAN GOVERNMENT RAILWAY (Survey) for a tour of 12 to 18 months, with possible extension. Free passages and a commuted bush, travelling and detention allowance of £9 a month whilst on duty in the Colony. Camp equipment provided. Outfit allowance of £60 on first appointment. Liberal leave on full salary. Salary £480 for the first three years of service, then £510, rising by annual increments to £920 a year. Candidates must have passed examination to qualify for A.M.I.C.E. or hold equivalent professional qualifications and have had experience on Railway Survey, preferably location.—Apply at once by letter, stating age, qualifications, and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, Westminster, London, S.W. 1, quoting M/15135. 6303

Assistant Engineers (14) REQUIRED for the PUBLIC WORKS DEPARTMENT of the FEDERATED MALAY STATES for four years' service, after which subject to satisfactory service the officers appointed will be eligible for confirmation in the permanent and pensionable establishment. It is probable that the number of permanent appointments will be sufficient for those officers whose services have been entirely satisfactory, but no guarantee can be given. If at the end of four years' service an officer's services have been entirely satisfactory, and he is not offered or declines further employment, he will be paid a bonus of 2850 dollars. Salary 400 dollars a month, rising to 800 dollars by annual increments of 25 dollars, plus a temporary non-pensionable allowance of 10 per cent. for bachelors and 20 per cent. for married men. The exchange value of the dollar in sterling is at present fixed by the Government at 2s. 4d., but its purchasing power in Malaya is considerably less than that of 2s. 4d. in the United Kingdom. No income tax at present imposed by the Federated Malay States Government. Free passages provided. Candidates, age 23 to 26, preferably unmarried, must have received a good theoretical training, preferably at a University or College recognised by the Institution of Civil Engineers, and possess a Civil Engineering Degree or obtained such other Diploma or Distinction in Engineering as the Secretary of State may decide in any particular case or have completed articles with a Civil Engineer of good standing, and have passed the examination for Associate Membership of the Institution of Civil Engineers. In addition, candidates must have had at least one year's practical experience of Civil Engineering under a qualified civil engineer.—Apply at once by letter, giving brief details of qualifications and experience and stating age, and whether married or single, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, Westminster, S.W. 1, quoting clearly at the head of application M/15,224. 6282

Draughtsmen Required Singapore. Must have served articles with 3 years' subsequent experience architects' offices and able to prepare architectural working drawings and specifications.

Experience survey and preparation layout plans for considerable areas desirable.

Age under 40 years, preferences ex-Service men.

Salary £140-7½-£200 a year plus bonus (totalling approximately £225-£308) plus foreign service allowance 4,300 dollars if single, 5,700 dollars if married.

Apply in writing, SECRETARY (W.B.5), Air Ministry, London, W.C. 2. 6302

Crystal Palace School of Practical Engineering.
Founded 1872.
MECHANICAL AND CIVIL ENGINEERING DIVISIONS.
PRESIDENT: J. W. WILSON, M.I.C.E., M.I.M.E.
PRINCIPAL: MAURICE WILSON, M.I.C.E.
Assisted by Staff of Lecturers and Instructors.
Thorough, up-to-date Practical and Theoretical Instruction. Course completed in 2 years.
Students admitted at beginning of any term. 5881

The Engineer

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PUBLIC NOTICES

Armstrong College,
NEWCASTLE-UPON-TYNE.
(IN THE UNIVERSITY OF DURHAM.)

COURSES for the PASS DEGREE of B.Sc. and the HONOURS DEGREE of B.SC. in MECHANICAL, MARINE, CIVIL or ELECTRICAL ENGINEERING, MINING, METALLURGY, or NAVAL ARCHITECTURE. The curricula of the Pass Degree and the Honours Degree normally occupy periods of three and four years respectively, but candidates presenting evidence of sufficient previous training may be allowed to proceed to either Degree after two years' residence.

The engineering laboratories have recently been extended, and all Departments are equipped for advanced tutorial and research work.

Full particulars of the Courses may be had on application to

THE REGISTRAR,
Armstrong College,
5805 Newcastle-upon-Tyne.

University of Manchester.
DEPARTMENT OF ELECTRICAL ENGINEERING,
DEPARTMENTS OF CIVIL, MECHANICAL AND ELECTRICAL ENGINEERING.

Full particulars of these COURSES will be forwarded on application to the REGISTRAR. The Session commences on Thursday, October 6th. 6253

PUBLIC NOTICES

City of Cardiff Education COMMITTEE.
THE TECHNICAL COLLEGE.
Principal: CHARLES COLES, B.Sc. (Lond.).
DEPARTMENT OF ENGINEERING.
Head of Department: A. W. LOVERIDGE, B.Sc. (Eng.), A.R.C.Sc.
SESSION 1927-28.
(Commencing on Tuesday, 4th October, 1927.)

The following Courses have been arranged for engineering students :—

A Three Years' Course in Mechanical and Marine Engineering jointly with the University College of South Wales and Monmouthshire.

A Two Years' Course for apprentices and others with facilities for practical experience in the Summer Term.

These Courses are suitable for students preparing for Degrees in Engineering or for the Examinations of the Engineering Societies.

Special Courses are also arranged for Marine Engineers preparing for the Examinations of the Board of Trade.

OPEN SCHOLARSHIPS, covering tuition fees and maintenance grants of £40 per annum for three years, are offered for competition annually, and candidates for entry to the above Department are eligible to compete.

For further particulars of Full-time and Part-time Courses, Entrance Examination, Scholarships, Fees, &c., apply to the Principal. Application forms for entrance scholarship examination, duly filled up, must be received before September 17th.

JOHN J. JACKSON,
6317 Director of Education, City Hall, Cardiff.

The Polytechnic,
309, REGENT-STREET, W. 1.
STUDENTSHIP EXAMINATION OF THE INSTITUTION OF MECHANICAL ENGINEERS.
PRELIMINARY EXAMINATION, INSTITUTION OF CIVIL ENGINEERS.
FINAL EXAMINATION, INSTITUTION ELECTRICAL ENGINEERS (Part 1).

Special Courses have been arranged for Students taking the above Examinations. The syllabus covers all the work in PURE MATHEMATICS, MECHANICS, PHYSICS, ENGLISH and FRENCH.

Fee for the Course £2 2s.

Prospectus free on application to the DIRECTOR OF EDUCATION. 6301

PUBLIC NOTICES

The Polytechnic,
309, REGENT-STREET, W. 1.
SCHOOL OF ENGINEERING.

President of the School: The Hon. Sir CHARLES PARSONS, O.M., K.C.B., M.A., LL.D., D.Sc., F.R.S., &c.
Head of Department: ALEX. B. HORNE, O.B.E., B.Sc. (Hons. Eng.), F.R.S. (Edin.), &c.

The DAY DEPARTMENT RE-OPENS on SEPTEMBER 20th, 1927. Entrance Examination commences September 12th, 1927, at 9.30 o'clock.

Three-year DIPLOMA COURSES in—
MECHANICAL ENGINEERING,
STRUCTURAL ENGINEERING,
ELECTRICAL ENGINEERING,
MOTOR CAR ENGINEERING.

Practice in the Laboratories, Drawing-office, Work shop and Field.
Fee, 21 Guineas per annum.
There are three Entrance Scholarships in Structural Engineering.

The EVENING DEPARTMENT RE-OPENS on SEPTEMBER 26th, 1927. Students enrolled from September 14th, 1927.

The Day and Evening Courses are recognised for the Diplomas and Certificates issued by the Institutions of Mechanical and Electrical Engineers in conjunction with the Board of Education.
Full prospectus free on application to the DIRECTOR OF EDUCATION. 6250

UNIVERSITY OF LONDON.
King's College.
FACULTY OF ENGINEERING.

COMPLETE COURSES of STUDY are provided in CIVIL, MECHANICAL and ELECTRICAL ENGINEERING for the Engineering Degrees of the University of London and for the Diploma and Certificate of the College.

HEADS OF DEPARTMENTS:
Professor G. COOK, D.Sc., M.I. Mech. E., A.M. Inst. C.E., Mechanical Engineering (Dean).
S. J. DAVIES, M.Sc., M.I. Mech. E., Reader in Mechanical Engineering.
Professor A. H. JAMESON, M.Sc., M. Inst. C.E., Civil Engineering.
C. H. LOBBAN, D.Sc., A.M. Inst. C.E., Reader in Civil Engineering.
Professor E. WILSON, M. Inst. C.E., M.I.E.E., Electrical Engineering.
F. S. ROBERTSON, M.I.E.E., Senior Lecturer.
Professor S. A. F. WHITE, M.A. } Mathematics.
Professor A. E. JOLLIFFE, M.A. }

Considerable extensions have been made in the Engineering Department. These include a large additional drawing-office, lecture room and laboratory for Hydraulics and Strength of Materials in the Civil and Mechanical Departments, and research rooms, including Wireless Telegraphy, in the Electrical Engineering Department. Large additions have been made to the equipment of the Laboratories in the three Departments for purposes of teaching and research.

There is a College Hostel and a large Athletic Ground.

For full information apply to the SECRETARY, King's College, Strand, W.C. 2. 6073

University of Manchester.
PHYSICS DEPARTMENTS.

Full particulars of the LECTURES and LABORATORY COURSES in PHYSICS, preparing for both the Ordinary and the Honours Degrees, will be forwarded on application to the REGISTRAR.
The Session commences on Thursday, October 6th. 6254

University of London, King's COLLEGE.
The Delegacy will REQUIRE in October next the SERVICES of an ASSISTANT LECTURER in MECHANICAL ENGINEERING. Salary £300 per annum.—Applications, accompanied by three copies of three recent testimonials, must reach the SECRETARY, King's College, Strand, W.C. 2, from whom particulars and forms of application may be obtained, not later than 16th September. 6305

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PUBLIC NOTICES

Denbighshire Education AUTHORITY.
DENBIGHSHIRE TECHNICAL INSTITUTE, WREXHAM.

APPLICATIONS are INVITED for the POST of LECTURER in MINING.

Salary in accordance with the Burnham Scale for Technical Teachers.

Good qualifications and experience desirable.

Particulars of the appointment may be obtained from the undersigned, to whom applications should be forwarded not later than Saturday, the 17th September.

Duties to commence on the 1st October.

J. C. DAVIES,
Secretary and Director of Education.

Education Offices, Ruthin,
23rd August, 1927. 6331

The Yarrow and William LINDLEY SCHOLARSHIPS.

The Council of the Institution of Civil Engineers are prepared to consider APPLICATIONS for APPOINTMENT to the above SCHOLARSHIPS. These should be submitted before the 17th September, 1927, to the SECRETARY of the Institution at Great George-street, Westminster, S.W. 1, from whom the detailed regulations may be had on application.

Applicants for the Yarrow Scholarships must be British subjects who are not more than 23 years of age and who, desiring to become engineers, lack sufficient means to enable them to pursue their practical training or their scientific education. The Scholarships are ordinarily of values from £50-£100 per annum for one, two, or three years.

Applicants for the William Lindley Scholarships must not be more than 23 years of age and must be children of Corporate Members of the Institution whose means are inadequate to defray all the expenses incidental to an engineering training. The fund provides for (a) a major scholarship of £80 per annum for engineering study at Cambridge University, tenable for three years; and (b) a scholarship of £40 per annum for scientific education or practical training in engineering. 6077

Metropolitan Water Board.
TENDERS FOR THE SUPPLY OF MILD STEEL FENCING.

The Metropolitan Water Board invite TENDERS for the SUPPLY of approximately 1 MILE of MILD STEEL FENCING for their Queen Mary Reservoir at Laleham, Middlesex. The fencing is to be in 9ft. panels, 5ft. high, in accordance with drawing No. 21, 3063/7, and no gates are required. The fencing is to be delivered to the site of the works near Laleham (nearest station Ashford, Middlesex, Southern Railway) and will be erected by the Board.

Tenders must be submitted on the official forms, which may be obtained (together with specification and copy of drawing) from the Chief Engineer, on and after Monday, 22nd August, 1927, by personal application at the Board's Offices (Room 136) or upon forwarding a stamped addressed brief envelope.

Tenders, enclosed in sealed envelopes addressed to the Clerk of the Board, and endorsed "Tender for Fencing," must be delivered at the offices of the Board (Room 122), not later than 11 a.m. on Thursday, 8th September, 1927.

The Board do not bind themselves to accept the lowest or any Tender.

G. F. STRINGER,
Clerk of the Board.

Offices of the Board,
173, Roseberry-avenue, E.C. 1,
20th August, 1927. 6309

Port of Bristol Authority.
QUAY PNEUMATIC GRAIN ELEVATORS AND CONVEYORS, SHEDS "U" AND "V," ROYAL EDWARD DOCK, AVONMOUTH.

The Port of Bristol Authority is PREPARED to receive TENDERS for QUAY PNEUMATIC GRAIN ELEVATORS and CONVEYORS for Sheds "U" and "V" at the Royal Edward Dock, Avonmouth.

On and after Monday, the 22nd August, copies of the specification and contract drawings can be obtained from the undersigned on production of a receipt showing that a deposit of £5 has been paid. All cheques must be made payable to the Port of Bristol Authority and forwarded to the General Manager and Secretary, Docks Office, 19, Queen-square, Bristol. The deposit will be returned to bona fide tenderers after the receipt of the Tender with all the prescribed documents and drawings.

Tenders must be enclosed in a sealed envelope, endorsed "Tender for Quay Pneumatic Grain Elevators and Conveyors," addressed to the General Manager and Secretary of the Port of Bristol Authority, 19, Queen-square, Bristol, and must be delivered to him, accompanied by all the prescribed documents and drawings before 10 a.m. on Monday, the 19th day of September.

The Port of Bristol Authority does not bind itself to accept the lowest or any Tender.

THOMAS A. PEACE,
Engineer.

Chief Engineer's Office,
Avonmouth Docks,
17th August, 1927. 6292

ENGINE AND BOILERS FOR DISPOSAL.

The Commissioners of the Sutton and Mepal Drainage District invite TENDERS for the ENGINE, BOILERS and WATER WHEEL, as now standing in their Engine House, near Mepal, Cambridgeshire, as follows, viz.:—

TENDER No. 1.—For THREE BOILERS, about 27ft. long by 7ft. 6in. in diameter, with all valves and fittings, as now working in the boiler house.

TENDER No. 2.—For the 250 H.P. BEAM ENGINE and WATER WHEEL now coupled to the engine, and all fittings, including two columns, as now in the engine and wheel house, excepting chains, spanners, rope tackles, crab, hand pump and all girders.

TENDER No. 3.—For the BOILERS, ENGINE and WATER WHEEL in one Lot, as specified in Tenders Nos. 1 and 2.

Parties tendering are particularly requested to state the earliest date on which they can dismantle and clear.

Any unreasonable damage caused by dismantling to the buildings to be made good.

There is a high road up to the engine.

The Commissioners do not bind themselves to accept the lowest or any Tender.

Tenders to be sent to me not later than Monday, 29th August, next.

C. T. HAMMERTON,
4, Market-hill,
Chatteris, Cambs.,
6266 Clerk to the Commissioners.

Royal State Railways of Siam.

BOILERMAKER WANTED by the above Railways. Applicant, who will probably be appointed foreman, must be a first-class man with at least five years' experience in Railway Workshops on Repairs to Locomotive Boilers. Age about 30, and single. The engagement will be for three years in the first instance, at a salary of 450 ticals per month for the first year, 475 ticals per month for the second year, and 500 ticals per month for the third year (11 ticals equals £1 approximately). £80 passage money allowed.—Apply by letter to Messrs. SANDBERG, 40, Grosvenor-gardens, London, S.W. 1, giving full particulars of experience, together with copies of references. 6340

SITUATIONS OPEN

COPIES OF TESTIMONIALS, NOT ORIGINALS, UNLESS SPECIFICALLY REQUESTED.

WANTED, ASSISTANT ENGINEER for Maintenance of Heavy Machinery AC and DC Electrical Plant; must be thoroughly experienced.—Apply to BRITISH GOODRICH RUBBER CO., Limited, Leyland, giving experience, age and salary required. 6285 A

WANTED, ENGINEER, Capable of Looking After Steam Power Plant, Steam Engine Superheated Steam, Electrical Plant and Cooling Plant, also capable of doing all repairs.—Address, P3555, The Engineer Office. P3555 A

SITUATIONS OPEN (continued)

WANTED, ESTIMATOR (Engineering). Must be a capable man and experienced in estimating all classes of engineering work, plant and buildings.—Address, stating qualifications and experience, 6326, The Engineer Office. 6326 A

WANTED, Experienced COST CLERK (Engineers), first-class references required.—Address, stating particulars of experience, with copies of references, 6299, The Engineer Office. 6299 A

WANTED, Good Practical BRIDGE DESIGNER for Calcutta. Only men having had experience in design of important bridges need apply. Salary equivalent of about £1000 p.a.—Apply, giving fullest particulars of age, experience, &c., to BRAITHWAITE and CO., ENGINEERS, Ltd., Broadway-buildings, Westminster. 6307 A

WANTED, MANAGER, to Take Entire Charge of Works in the Midlands, making Bolts, Spikes, Telegraph Material and Small Forgings. Must be a first-class man.—Address, P3565, The Engineer Office. P3565 A

WANTED, SALES PROMOTION ENGINEER, with extensive knowledge of Engineering Concerns, to assist in sales organisation in an Aluminium Foundry and Engineering Works, near London.—Address, stating age, salary required, and full details of experience, 6267, The Engineer Office. 6267 A

WANTED, Young QUALIFIED ENGINEER, with experience of tar or oil plant construction, as DRAUGHTSMAN-DESIGNER. State age, education, training, experience, and salary required.—Address, 6344, The Engineer Office. 6344 A

A RESIDENT ENGINEER is REQUIRED for service in British East Africa.

Candidates, to be considered, must have technical Training, University Engineering Degree or Diploma of one of the principal Engineering Colleges, Workshop, Drawing Office, and a wide General Engineering Experience, including the design, erection maintenance and running of Chemical Plant and Machinery, Diesel Engines, Alternating-current Generators, Motors, Furnace Work, and a good knowledge of surveying.

The selected candidate, must pass strict medical examination before engagement.

Salary according to qualifications, with a minimum of £800 per annum.

Apply in writing, stating age, full particulars of training and experience, and when could be at liberty, to P3515, The Engineer Office. P3515 A

ASSISTANT MANAGER REQUIRED for Railway Wagon Works in India. Bachelor, not over 24. Must be fully conversant with the most recent methods for manufacturing All-steel Wagons.—Reply fully, stating age, education, training, experience, and present salary, to "Z.Y. 932," c/o Deacon's Advertising Agency, Fenchurch-avenue, London, E.C. 3. 6334 A

ELECTRICAL ENGINEER REQUIRED for Trinidad, to Take Full Charge Erection and Operation of Oilfields Electrification Scheme. Gentleman of good education, with sound practical experience running and maintenance of turbine and Diesel generating plant, 3-phase distribution and power and lighting equipment, both on mechanical and electrical sides. Must be accustomed position of responsibility and possess administartive ability and initiative for further development of scheme. Previous experience abroad desirable but not essential. Age about 35. Commencing salary £60 to £70 per month, according to qualifications, with free quarters and supplementary advantages. Excellent prospects offered to right man.

Applications, by letter only, with fullest particulars, to PREECE, CARDEW and RIDER, 8, Queen Anne's-gate, Westminster, S.W. 1. P3550 A

FOUNDRY MANAGER WANTED for Large Foundry in North of England. A qualified engineer with good experience of foundry management and organisation will be preferred.—Address, with detailed particulars and state salary required, 6314, The Engineer Office. 6314 A

MECHANICAL ENGINEER REQUIRED, Over 35, for Copper Mine in West Cork, Ireland. Experience in maintenance of 200 H.P. Semi-Diesel Oil Engines, 200 H.P. Suction Gas Engines, Air Compressors, Electric Lighting Plant, and Erection Machinery essential. Knowledge of rock crushing and grinding plant a recommendation. Furnished small house and coal free. Applicants must state definitely age, salary required, and when can start work. It is useless to apply without above qualifications. Copies only of testimonials to be sent, as originals cannot be returned.—Address, P3546, The Engineer Office. P3546 A

MECHANICAL ENGINEER REQUIRED at Rolling Mills in South Wales. Applicants must have had sound practical experience in erection, repairs and maintenance of Mill Plant, Steam Engines, Hydraulic and Pneumatic Plant, Large and Small Machine Tools and Accessories, and all the requirements of General Engineering in a large works. Preference given to applicant who has also received a sound theoretical training.—Address, with full particulars of training, experience, age, and salary required, 6320, The Engineer Office. 6320 A

REQUIRED, FULLY-QUALIFIED METALLURGIST, with modern methods, capable of taking charge of Steel and Ironworks Laboratory and Test House.—Address, in first instance, giving age, full particulars of experience and qualifications and salary expected, 6260, The Engineer Office. 6260 A

THE SERVICES of a First-class Man (British Subject), thoroughly well versed in Management of Linde production and sale of oxygen, IMMEDIATELY REQUIRED under contract for terms of years in British Dominions; interest in returns.—Write, stating salary required, giving full particulars of experience, to Z.L. 965, care Deacon's Advertising Offices, Fenchurch-avenue, E.C. 3. 6335 A

WANTED for Development and Research Department, DRAUGHTSMAN interested in trying out new ideas. Knowledge of hydraulics advantageous.—Apply, GLENFIELD and KENNEDY, Ltd., Kilmarnock. 6300 A

CONSTRUCTIONAL DRAUGHTSMAN, Capable detailer and reliable checker, WANTED. State age and salary required.—BANISTER, WALTON and CO., Ltd., Trafford Park, Manchester. P3553 A

CONSTRUCTIONAL ENGINEERS REQUIRE DRAUGHTSMAN; one with good knowledge of outside Iron Staircase Work preferred.—Address, 6304, The Engineer Office. 6304 A

DRAUGHTSMAN (Capable) WANTED, Thoroughly experienced in marine, steam and oil engine design and pipe arrangement work. Salary, £5 to £5 10s. per week. State age and experience.—Address, 6283, The Engineer Office. 6283 A

DRAUGHTSMEN (LOCOMOTIVE) WANTED; juniors with about four years' drawing-office experience at locomotive work.—Apply, giving full particulars, to NORTH BRITISH LOCOMOTIVE COMPANY, Limited, 110, Flemington-street, Springburn, Glasgow, N. P3566 A

DRAUGHTSMAN REQUIRED in Engineer's Office, experienced in structural work. State experience, age, salary required.—Address, P3570, The Engineer Office. P3570 A

DRAUGHTSMEN REQUIRED for Factory in North of England, accustomed to General Works Extensions and Maintenance of Plant and Buildings. Must have initiative and energy.—Address, P3557, The Engineer Office. P3557 A

CONSTRUCTIONAL DRAUGHTSMAN WANTED with sound theoretical knowledge and practical experience in all classes of constructional work.—Apply, stating age, qualifications, salary required, to MANAGER, Constructional Department, The Frodingham Iron and Steel Co., Ltd., Scunthorpe, Lincs. 6343 A

DRAUGHTSMAN REQUIRED, with Experience in the Design of Concrete Mixing Machinery. State age, experience, and salary required.—Address, 6316, The Engineer Office. 6316 A

SITUATIONS OPEN (continued)

EXPERIENCED DRAUGHTSMEN REQUIRED accustomed Crushing, Grinding, and Cement Making Machinery.—Apply, stating age, experience, salary required, to "W. J. C.," Edgar Allen and Co., Ltd., Imperial Steel Works, Sheffield. 6262 A

REQUIRED by London Firm, TWO STRUCTURAL DRAUGHTSMEN accustomed to Buildings of all descriptions. Preference given to men capable of carrying jobs through themselves.—Address, P3571, The Engineer Office. P3571 A

REQUIRED, DESIGNER ELECTRIC CRANES, also DETAILING DRAUGHTSMEN.—Age, experience, salary, when free, to Box "PULSATION," 95, Bishopsgate, E.C. 2. 6310 A

REQUIRED, First-class AERONAUTICAL DRAUGHTSMEN, with full knowledge of the requirements of Aircraft Design. Only men with sound experience need apply. State full experience and salary required.—Address, 6324, The Engineer Office. 6324 A

REQUIRED IMMEDIATELY for a Period of from 6 to 12 months, a capable DRAUGHTSMAN DESIGNER for Steel-frame Buildings.—Apply personally between 10 a.m. and 4 p.m., with references, to CHIEF CIVIL ENGINEER, Metropolitan Railway, Baker-street Station. 6319 A

SENIOR REINFORCED CONCRETE DESIGNERS (TWO) REQUIRED, with specialist training.—Address applications, stating age, experience, and salary required, 6308, The Engineer Office. 6308 A

STRUCTURAL DRAUGHTSMAN REQUIRED, Able to design Steel-frame Buildings, &c., and carry out contracts without supervision. Only competent men need apply. State experience, age, salary required, and when at liberty. Yorkshire district.—Address, P3560, The Engineer Office. P3560 A

WANTED, FOREMAN ENGINEERS: Must Have had sound experience in construction and maintenance of Chemical Plant, capable of supervising all trades. Must be energetic, tactful and strict disciplinarians.—Address, stating experience, 6325, The Engineer Office. 6325 A

TOOL-ROOM FOREMAN REQUIRED. Applicants must have had exceptionally good experience in the making of Hobs and Chasers used on Precision Screwing Machines, and sound knowledge and experience of modern methods of Gauging Screw Threads. Only first-class men need apply, with full particulars of experience, age, and wages required.—Address, 6321, The Engineer Office. 6321 A

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For continuation of Small Advertisements see page 3.

A Seven-Day Journal

The Nag Hammadi Barrage.

Following the recent announcement that Sir John Jackson, Ltd., had received the contract for the new barrage on the Nile at Nag Hammadi, it is of interest to learn that Ransomes and Rapier, Ltd., of Ipswich, have now received the order for the sluice gates and operating machines in connection with the scheme. The Nag Hammadi project forms the next step in the irrigation of the Nile Valley, which began in 1899 with the construction of the Assouan Dam, followed by the Esna Barrage, built in 1908, and the Sennar Dam opened in January of last year. The sluice gates for all these works were supplied by Ransomes and Rapier. The site for the new barrage, which will be over half a mile in length, is situated some 367 miles up the river from Cairo, between the existing barrages of Assiut and Esna. The object of the barrage is to raise the level of the river upstream sufficiently to command the irrigation canal, which will take off just above the barrage, and thereby irrigate an area of approximately 500,000 acres at all seasons of the year. Formerly it was possible to irrigate that area only at times of high flood. The scheme will enable two crops per annum to be grown instead of one, and will avoid the risks of incomplete irrigation caused by low levels and the consequent failure of the crops. The contract secured by the Ipswich firm covers the supply of roller type gates for the hundred openings in the main barrage and for the six openings at the head of the irrigation canal. Each opening is provided with two gates of 6 m. span running in parallel grooves, which will permit of the gates being lifted out separately if desired. The gates will have a depth of 6·1 m., 7·1 m. or 8·1 m., according to their position in the barrage. Two power-driven machines travelling on rails on the top of the barrage will be provided for operating the gates to regulate the flow of water through the openings, and also for removing the gates when necessary. A small machine will work on the canal head for the regulation of the gates controlling the flow of water into the canal. The contract price is approximately £170,000, and covers the complete manufacture of the sluice gates and accessories at the firm's Ipswich works, and for erection at the site. The work will be begun forthwith and will occupy a period of two and a-half years.

Tobu Railway Electrification.

From the Tobu (Japan) Railway Company the English Electric Company has received an order for motor and trailer coach equipments for the branch line that is being electrified from Sugito, on the Asakusa-Kuzuu line, to Nikko, a distance of about fifty miles. The order was obtained in the face of strong international competition, and it is the fourth order that the Tobu Railway has placed with the English Electric Company. The order includes twenty-eight motor coach equipments, each consisting of four 130 horse-power motors wound for a pressure of 750 volts, for operating on a 1500-volt line. The control gear is of the maker's cam shaft under-car type, arranged in two boxes, which are slung underneath the coaches. A two-kilowatt 1500/120 volt motor generator set supplies the operating current and the whole of the lighting. Sixteen trailer coach equipments are also being supplied. A normal train unit will consist of one motor coach and one trailer, and a train will be made up of one or more of these units. Alternatively a unit can consist of two motor coaches and one trailer. The current is collected by means of two pantographs controlled on the electro-pneumatic system. Two completely automatic rotary converter sub-stations are being erected for providing the 1500 volt direct-current. The sub-stations will be fed on the 50-cycle three-phase side at a pressure of 3300, and each sub-station supply will be controlled by 50,000 kilovolt-ampère switchgear. Each sub-station will be equipped with two 500 kilowatt and 1500-volt rotary converters, which will be started by means of tappings on the low tension side of the transformers. The value of the contract is approximately £60,000.

Empire Airship Services.

Some few months ago representatives of the Air Ministry left this country on a visit to Africa and Australia, with a view to the establishment of airship stations or mooring towers at suitable points. With the approaching completion of the new British airships R 100 and R 101, the ground organisation required for testing them on various Empire routes is becoming a matter of some urgency. So far, however, that organisation is within measurable distance of being provided only on the route from England to Karachi *viâ* Egypt. Certain of the Dominions have proved slow to move in the matter. Even Australia, usually regarded as the most progressive of the Dominions in the matter of establishing aerial communication with the Mother Country, is adopting a very cautious attitude over the question of providing airship station facilities. Mr. Bruce, the Federal Prime Minister, discussing the object of the Air Ministry representatives' visit, has made it clear that up to the present the Australian Government has not committed itself to any expenditure in connection with the scheme. From his subsequent remarks it is evident that his Government intends to await the successful trial of the new airships and the demonstration of the practicability of their employment. While the Indian route will provide a fair test for the airships, it is doubtful whether it will provide all the conditions for a complete one. Without additional enterprise on the part of the Dominions, it is difficult to see how the practicability of the Empire airship services can be fully determined.

French Naval Strategy.

The commissioning of the British battleships Rodney and Nelson has been made the occasion by French naval experts for the expression of opinions upon the value of the battleship in future naval warfare. It is argued that battleships are an expensive luxury which may be justified if means are provided for bringing them to the scene of action, where they may have devastating effects, particularly for coast bombardment, but in the opinion of the French experts the methods of warfare are changing so completely that the battleship may be afforded little opportunity of taking the offensive. It is suggested that a submarine may leave a zone of poisonous gas through which a vessel will unsuspectingly pass with probably the total loss of all on board. Compasses can be deviated and torpedoes will be discharged from considerable distances. In short, it is suggested that there are many possible developments which will change the whole aspect of naval strategy. The French have had to abandon battleships because they are unable, at present, to bear the expense of constructing them, and they have become the champions of what is termed the "poor country's navy," that is to say, a fleet of submarines and light surface craft. They have gone back to the theory of Admiral Aube who, thirty years ago or more, argued that a flotilla of small and fast craft would have the better of the battleship, and this was for a long time the theory of the "new school" of naval strategists, who, however, failed to influence the ideas of those responsible for the development of the French Navy. Under present circumstances the theory is accepted, because it is based upon necessities, and recent discussion upon what is likely to be done in the future shows that it is also based largely upon imagination.

Underground Telephone Cables.

In carrying out the scheme for placing all the French trunk telephone lines underground the Département des Postes et des Télégraphes started with the shorter lines from Paris to Havre, Lille and Boulogne. Arrangements are now being made to place the cable underground between Paris and Marseilles. The work has already been started in the neighbourhood of Dijon, where a concrete trench varying in depth from 2ft. to 2ft. 8in. is being made towards Paris. In this trench will be placed a cable of 420 wires, insulated in the most perfect manner possible, and the cable will be employed both for telegraphy and for telephone messages. Amplifiers will be installed at distances varying from 45 to 60 miles, and the buildings for housing four sets of amplifiers are now under construction between Paris and Dijon. The work is to be completed in three years at a cost of about 150 million francs. It is expected that eventually the big towns in the eastern departments will be connected up with the Paris-Marseilles line, and that all the trunk telegraph and telephone lines will, in time, be placed underground.

New Avoiding Lines on the Southern Railway.

Goods trains from what used to be the Midland and Great Northern railways with traffic for the Southern Railway, are worked through by their own engines to large exchange sidings at Hither Green, and then perform a return trip with wagons for the North from the Southern. Hither Green is situated on the main line between Charing Cross and Tonbridge, and the trains in question reach there by passing over the Metropolitan Railway and then through Holborn, join the Charing Cross main line at Metropolitan Junction near London Bridge. Since the introduction of the Southern Railway's electrical services the line in question has been very crowded, and the forty or so goods trains a day have had to be confined to the slack hours or run at night. A line carrying less traffic is the continuation of the connection, through Holborn, with the Metropolitan Railway, namely, the line through Elephant and Castle and then over the South London Railway, but it has no connection with the Charing Cross–Tonbridge line. The Southern Railway has, however, obtained powers in the present Session to construct, at an estimated cost of £275,000, a loop near St. Johns, which will join the South London–Greenwich Park line at Lewisham-road with the Blackheath line at Lewisham Junction, and another loop from Lewisham Junction to the Charing Cross–Tonbridge line. The work has now been ordered, and, when completed, trains will be able to avoid the busy London Bridge line, and it will be possible to run seventy or eighty trains a day. Further, trains from the Great Western and London, Midland and Scottish, *viâ* the West London Extension, will also be able to get to Hither Green. The new lines are to be equipped with the four-aspect colour light signals, introduced last year at Holborn, Charing Cross and Cannon-street.

Cruiser Contracts in America.

A somewhat unusual and novel procedure has been adopted by the three firms which have been successful in securing contracts for the building of four 10,000-ton cruisers, the construction of which was authorised by the United States Congress in 1924. Two of the ships will be built by the Newport News Shipbuilding and Dry Dock Company, and one each by the American Brown Boveri Electric Corporation and the Bethlehem Shipbuilding Corporation. These three firms have now joined in founding a new company under the style of the Marine Engineering Corporation of Philadelphia, which will be responsible for getting out all constructional details that may be required by the shipbuilders and engineers engaged on the four cruisers. The new company will also be responsible for buying all material for the hulls and machinery equipment. The technical staff of the new undertaking includes engineers, naval architects, draughtsmen and others, which staff, we learn, has been mainly recruited from shipbuilding yards and marine engine works in the Delaware district.

The U.S. Navy Aircraft Carrier Lexington.

In an article published in our issue of July 1st, when reviewing the aircraft carrying vessels of the world, reference was made to the U.S. Navy aircraft carrier Lexington. According to recent news from America, that vessel will be ready for sea trials in about six months time. She is now in the final stages of construction at the Fore River plant of the Bethlehem Shipbuilding Corporation, Ltd. In several respects she is a noteworthy ship. Her length is 874ft., which allows of a flying deck 900ft. long, and she has a beam of 105ft. Her displacement is 33,000 tons and her designed speed over 33 knots. The Lexington will be propelled by turbo-electric machinery, which has been specially designed by the General Electric Company of Schenectady. It comprises four 35,200 kW turbo-generators, which will be supplied with steam from sixteen oil-fired boilers. There are four screws to run at 317 r.p.m., each of which will be driven by twin electric motors, each having a designed output of 22,500 S.H.P., giving a total machinery output of 180,000 S.H.P. Her auxiliary machinery will be electrically operated and will be supplied with energy by six direct-current turbo-generators, each of 750 kW output. Provision is made for carrying no less than 106 aeroplanes, which will be brought up on to the flying deck by means of electric lifts. The armament of the Lexington will include eight 8in. guns which are arranged in four twin turrets. There will also be twelve 5in. anti-aircraft guns, and twelve torpedo tubes will be fitted. The total cost of the Lexington has been estimated at £9,000,000.

A National Electricity Supply Scheme.

It is understood that the Electricity Commissioners have now worked out the first stage of the national electricity supply scheme, and have referred it to the Central Electricity Board, which was recently constituted under the Electricity Supply Act. Some details of the scheme will, it is hoped, be made known next month. The areas which will be first dealt with include, it is understood, London and the Home Counties, and also the South-East of England. Subsequently the industrial areas of the Midlands will be considered, following which Yorkshire and the North-East Coast, Lancashire and North Wales and South Wales and the West of England will be incorporated in the national scheme. In the Metropolitan area the London Power Company, which was formed in 1920 and which now controls the generating stations and main transmission lines of ten London electric supply companies, is engaged in co-ordinating the generation and transmission of electrical energy at a pressure of 22,000 volts within its area of supply, with a view to meeting the requirements of its constituent companies, until 1971, when its franchise terminates. At present it is extending the generating stations at Bow, Grove-road, Willesden, and Deptford by some 220,000 kilowatts of plant. In addition, the company has received authority to erect a station at Battersea, containing 360,000 kilowatts of plant, the first section of which is expected to be put into service for the winter of 1931–1932.

Southern Railway Disaster.

On Wednesday, August 24th, disaster overtook the Southern Railway express which left Cannon-street at 5 p.m. for Deal. For some reason not yet explained the train became derailed while travelling at a high speed between Dunton Green and Sevenoaks. A Pullman car sustained the brunt of the disaster, but most of the other coaches were also damaged. The latest available information places the casualties at twelve killed and about thirty injured.

An American Diary.

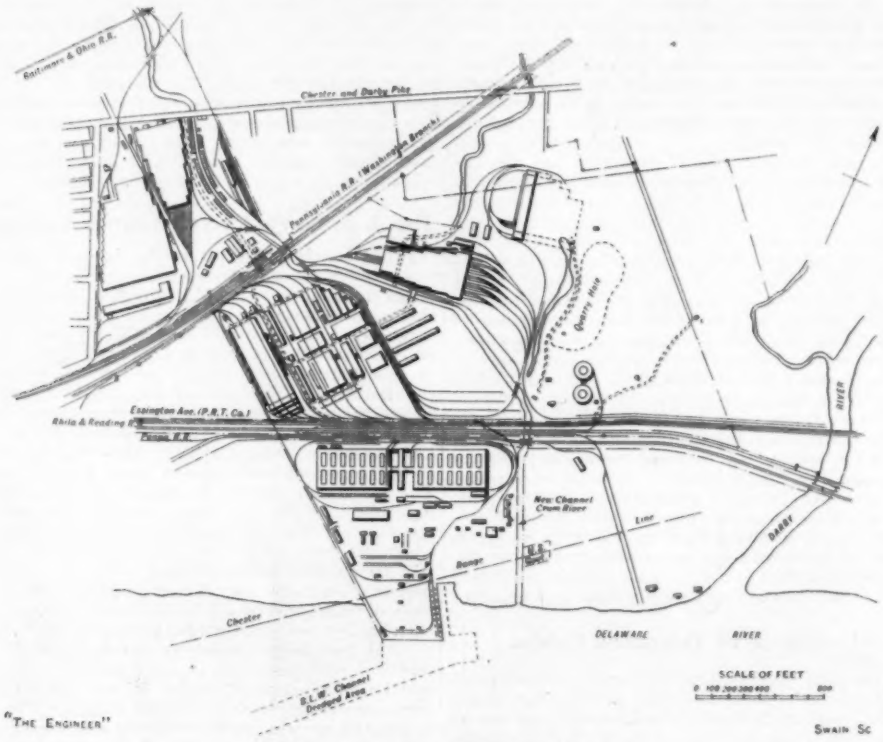
No. V.*

BALDWINS.

If you go to Philadelphia expecting to see locomotives still made at the famous old works, you will be disappointed. They have moved to more "commodious premises" outside the city. But if you go to the Philadelphia "works" you may find Mr. Sam Vauclain there, and that is always worth while. He will infect you with some of his unabated enthusiasm, he will tell you a lot about American industry, a lot about his own people, a lot about the works, and he *may* give you an autographed copy of his book which is entitled "Optimism." The locomotive trade is none too good in America: Baldwins are working far below capacity, but Mr. Vauclain is quite cheerful about the position. "The longer they put off buying new locomotives the more they will have to purchase in the end," he says. That is characteristic of Mr. Vauclain. He is always confident that there is a better time ahead. He is always certain that America will want ever so many more locomotives than it has, and that Baldwins will have the biggest share of the best orders. He is, perhaps, typical of Americans as a whole, and when one sees the opportunities that lie before them it is impossible to wonder at their optimism. He will, also, tell you, if you ask him, what he thinks of the internal combustion locomotive. You will hear him say that "the critter stinks"—a sound saying from a steam man—but where good water is scarce it has its field, and he will remind you that Baldwins made internal combustion locomotives to the patents of Mr. A. H. Ehle in 1910. Then, if your luck is really in, Mr. John P. Sykes, Vice-President in Charge of Plants and Manufacture, will turn up and offer to drive you out to the Eddystone works, fourteen miles or more along country roads, and, if you are still fortunate, there you will meet Mr. Ehst, the Comptroller, and Mr. Sanderson, so well known amongst railway people on this side, will greet you at the works gate. But Mr. Lawford Fry, another familiar personage for many years in this country, will not be there, for his business keeps him at the works of the Standard Steel Works Company, which is part and parcel of Baldwins.

Baldwins began by accident. The founder, Matthias Baldwin, was a jeweller. But trade was bad, and in 1825 he entered into partnership with David Mason, who made bookbinders' tools and cylinders for calico printing. That business flourished. One may guess that the serious Americans of those days were more interested in books than in gew-gaws. Manual power became insufficient and Baldwin decided to design and build a steam engine himself. What a glorious age when such things could happen! When a jeweller and a printer's mechanic thought nothing of making a steam engine. That old engine is still to be seen in the works, and for many years it did duty in various shops. It is a vertical, with the guide bars at each side of the cylinders and a forked connecting-rod going up to the crank above. At the very crest is a Watt centrifugal governor and, at a guess, from base to summit the engine must stand ten to eleven feet high. No small accomplishment for a jeweller and a printer's mechanic. It was a great success. Orders for duplicates came in and Baldwin and Mason were firmly established as steam engine builders.

It was 1830, and news of the famous locomotive trials at Rainhill were stirring the good people of Philadelphia. The proprietor of the local museum, Mr. Franklin Peale, desired to satisfy the tastes of his patrons. No doubt the museum was a "show" rather than the dignified establishment the word now means. In any case, Mr. Peale got Baldwin to build a miniature locomotive for him. The young engineer had only poor descriptions and rough sketches to guide him, but he actually turned out a little engine which hauled four passengers round a circular track made of pine boards covered with hoop iron. One thing leads to another, and the builders of the miniature engine were invited in 1831 to construct a real engine for the Germanstown and Norristown Railroad Company. A Stephenson engine of the "Planet" type was lying awaiting assembly in a shed at Bordentown. Peale and Baldwin were allowed to examine it and, so the story goes, from the scanty facts they were able to acquire in that way turned out the "Old Ironsides," which weighed five tons and performed all the usual wonders. From then onwards orders came in with astonishing rapidity, and Baldwins was fairly started upon the career which it has carried on for nearly a century.



PLAN OF BALDWIN'S EDDYSTONE WORKS

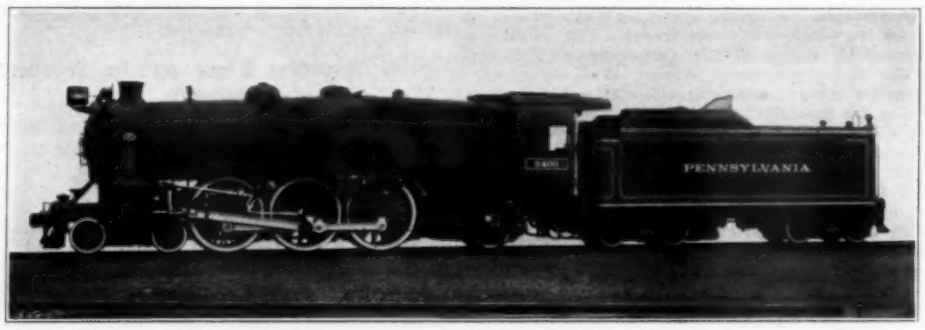
The new works at Eddystone, which are really post-war, though a beginning was made long before 1914, occupy more than thirty times the space of the old, for they cover in all about 616 acres. There are numerous shops and, as may be gathered from the plan, the water and railway service is admirable. It is to the erecting shops that the attention is attracted by their exceptional form—like truncated and stepped triangles. That plan is not fortuitous, but intentional. At each step of the triangle there is a doorway into the shop, through which the railway runs. The flow of material is transverse from side to side. The works manager will at once see how convenient such an arrangement is for the conveyance and transport of heavy material. These shops are just about 500ft. long.

If, when you enter, you can wrest your attention from the vast locomotives nearly or quite complete which surround you, a study of one of the jigs on which engines are erected will reward you. It consists essentially of a base upon which certain adjustable standards are mounted. The faces of the standards are truly upright and their distance apart can be adjusted. To them are bolted the complete bar frames, already machined. Then one by one the other essential parts are lowered into position between the frames. They just *have* to fit, for the frames are held rigidly, and, as a matter of fact, all the fitting faces are machined within fine limits so that they do fit. This method of erecting locomotives, for which, by the way, Baldwins secured a patent, is certainly expeditious.

The next thing that strikes the visitors is the surprising amount of steel castings that is used. The bar frames themselves are steel castings. They may be forty feet or more in length and have a general cross section about seven inches square with local thickening up to as much as eleven inches. Baldwins are quite satisfied with these frames, of which the Commonwealth Steel Company makes a speciality, and prefer them on all counts to forged frames. They are going a step further, for instead of casting the frames separately they are to be cast together, and with the cylinders included. It is a daring venture, and one foresees difficulties in machining which may not make it worth while.

Then neglecting small things which are now cast instead of being forged, or drop stamped, or malleabilised, the use of cast steel ashpans and tender bottoms and, of course, tender frames—all in one piece—may be mentioned. Fortunately, we have in this country a few firms quite capable of making such castings, firms which already do much heavier work for ships, and it would be interesting to know if our locomotive builders see possible economies in the method.

Another practice of great interest is the increasing use of welding. For example, the longitudinal seams of boilers are electrically welded by the vee notch method. The join is well hammered during the process. Then, again, a line of welding is run round the joint between the inner and outer fire-boxes and the foundation ring, and that troublesome little corner where the throat plate meets the barrel, always a ticklish spot for the caulker, is finished off by running a weld round it.



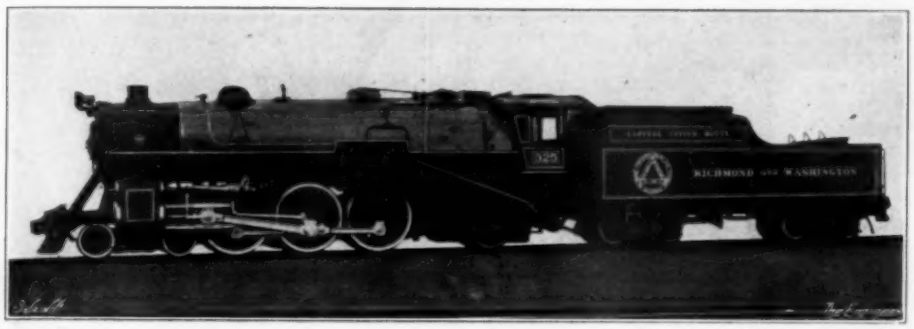
PASSENGER ENGINE, PENNSYLVANIA RAILROAD

Of course, the inner boxes are of steel and, of course, one asks why the Americans can use steel when Great Britain cannot. When Pantagruel was asked why monks liked kitchens, he replied cautiously: "I'll not offer to solve this problem, for it is somewhat ticklish, and you can hardly handle it without coming off scurvily; but I'll tell you what I have heard." What we have heard is that the Americans cannot make copper boxes and that the life of steel boxes is not long or free from troubles; but we have also heard that British engineers do not know how to make the right quality steel for fire-boxes, and that steel boxes are

* No. IV. appeared August 19th.

perfectly satisfactory and last quite long enough. As everybody knew both these statements long before, it cannot be said that anything useful was learnt about that standing difference between American and British locomotive practice.

The capacity of Baldwins is so great that even though the works were only at about two-thirds of capacity, many engines were to be seen, and a remarkable fact is that every one was fitted with an automatic stoker. That is some indication of the size, for it can hardly be worth using a stoker on a grate less than sixty square feet in area, but it must be remembered that Americans favour the wide shallow box and for the same tube area use a bigger grate than we do. As a matter of fact, however, most of the engines were very large, with grates of 70 to 88 square feet and 3800 to 5100 square feet and more of heating surface exclusive of the superheaters. Many of the fire-boxes were fitted with the thermic syphon, which, we need not remind our readers, is a very much flattened steel funnel running from the fire-box crown to the bottom of the front of the box. Devices of the kind in various forms were very familiar in the early years of locomotive history, but one by one have disappeared, even Drummond's cross tubes, and nobody seems to know whether they are really worth while or not. It may be that as boxes get bigger they become more desirable, and in any case they make a sort of gusset stay for the crown and add to the heating surface. On the other hand, however, they present large flat surfaces themselves.



PASSENGER ENGINE, RICHMOND AND WASHINGTON RAILROAD

But to get back to automatic stokers. Three types are in use, but they all have common characteristics. There is first of all a steam engine to drive them; frequently to be found in a steel cupboard fashioned in the near leading corner of the tender. It drives a horizontal worm, which not only conveys coal from the tender, but breaks it up fine. It does not pulverise it, of course; just breaks it very small. This coal is then fed into the box either at the sides a little above the footplate or is elevated by upright screw conveyors and delivered a good deal higher up. In either case it is distributed by a steam jet, which, with the assistance of the draught, keeps many of the particles floating until combustion is complete. The remainder is spread automatically over a thin fire.

There is no doubt that hand firing of these enormous engines is impossible, but if, like Rosa Dartle, you ask questions enough you will not know whether any of these stokers are really efficient. We may take it that they are economical because they economise in labour and enable locomotives to be run at full capacity; but there are reasons for suspecting that, taken day in and a day out, they waste a rare lot of coal. We were asked—to take a significant fact—by an engineer of authority on one railway—which shall be nameless—if ballast cleaning machines had made much progress in Europe, as he was anxious to investigate the question, for with the coming of the stoker his ballast needed frequent cleaning. Another engineer with an international reputation assured us that the grass on the sides of the railways were inches deep in half-burnt coal particles! Here, once more, with Pantagruel we only tell you what we have heard. In any case, mechanical stokers have to be used because hand firing is out of the question, and we do not doubt that as time goes on defects, if they exist, will be removed.

When the works are full about 18,000 men are employed by Baldwins, and a great many of them are paid on the contract system. That is to say, one of the men enters into a contract with the firm to construct a boiler or erect an engine, let us say, for a certain sum. He secures the men he wants and fixes their remuneration with them direct. The wages are paid by the firm to the men and the contractor takes what remains. There is, naturally, a good deal of emulation to become a contractor, but as the contractor is entirely responsible for the work and the time of delivery, only men who can control a gang and have the other requisite qualities are given that position. The plan, it will be seen, is quite automatic and the contractor takes good care that there is no loafing. The shop is an "open" one and the hours are fifty-five per week. There are no works committees or equivalent organisations and strikes are unknown. The contract system is, of course, not unfamiliar in this country, but it is only in rare cases, in steel works perhaps, that it is carried out so completely as at Baldwins.

We have already said that Baldwins began the construction of oil engine locomotives many years ago, and we may refer very briefly to their latest design. It is still in the experimental stage. The arrangement consists of two engines side by side, each shaft fitted with a pinion which gears with a common helical wheel. The helical wheel is on the shaft of a dynamo which supplies current to motors on the axles. The normal speed of the engines is 450 r.p.m., but a 2 : 1 variation is possible. The road speed is regulated by an electric contactor of the familiar railway and tramway type and by the engine speed. The engines themselves are interesting. They are really of the opposed-piston type, but the cylinders are turned round from the opposed position until they are nearly side by side. As a matter of fact, they are very steeply inclined and each pair drives on to one crank pin. A manifest objection to this duplex arrangement is that it crowds up the engine compartment, and we imagine that the "cab" must be very hot on the road. As a matter of fact, there is very little room between the engines and the side walls. We need not add that the locomotive as a whole looks like a saloon.

It is impossible to leave Baldwins without a handful of photographs, and as they show the appearance of the most recent locomotives in America, we reproduce a few of them. Three of them are passenger and one a "freight" engine. All of them are fitted with stokers.

The Pennsylvania engine has 80in. wheels and two cylinders, 27in. by 28in. The working pressure is 205 lb. The grate area is 70 square feet and the fire-box is 10ft. 6in. long by 6ft. 10in. wide. The total heating surface is 4058 square feet and the maximum tractive force 44,460 lb. The superheater has 962 square feet.

The Richmond and Washington engine has 75in. wheels and two 27in. by 28in. cylinders. The working pressure is 210 lb. The grate area is 75·8 square feet, the heating surface 4175 square feet, and the superheater surface 1078 square feet.

GOODS ENGINE, A.T. AND S.F. RAILROAD

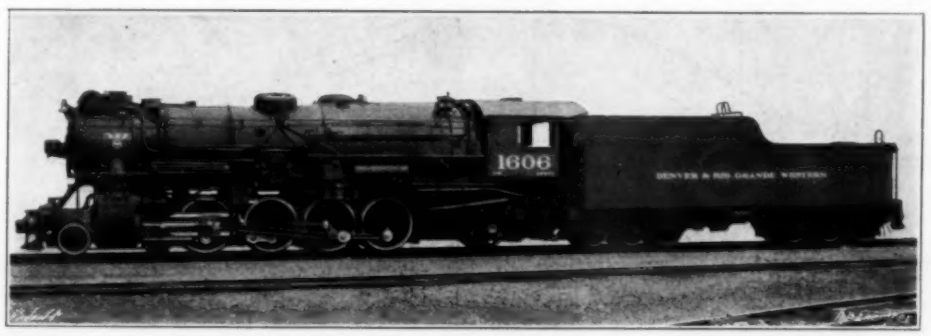
The tractive effort is 48,580 lb. Two large cross-compound pumps are provided for the air brakes.

The Denver and Rio Grande Western engine has 67in. wheels driven by three cylinders, 25in. by 30in. It is a passenger engine of the "mountain" type, and its tractive effort is 75,000 lb. with a working pressure of 210 lb. The grate area is 95 square feet and the heating surface, including two thermic syphons, is 5093 square feet, with a 1495 square foot superheater. The drum just in front of the chimney is probably a feed-water heater.

The A.T. and S.F. engine is a goods engine with 63in. wheels driven by 30in. by 32in. cylinders, which, with a working pressure of 220 lb., give a tractive effort of 85,360 lb. The heating surface is 5128 square feet, the superheater surface 1405 square feet, and the grate area 88·3 square feet. The fire-box in this case is over 11ft. long by 8ft. wide.

It will be noticed that in all these engines the fire-box is carried over a small pair of wheels so as to allow a great width to be attained.

(To be continued.)



MOUNTAIN TYPE PASSENGER ENGINE, DENVER RAILROAD

PLANS have, at last, been definitely approved as to the use to be made of the valuable free space at the Baker-street station of the Metropolitan Railway. The station itself was greatly improved and new administration offices built about 1908–1910. A hotel was then proposed, and a contract was entered into with the Strand Hotel Company to be the tenants. The financial outlook after the war changed the situation, and the chairman of the railway company announced at the annual meeting on February 10th, 1921, that that part of the scheme had been abandoned. A year later the announcement was made that the Stoll Picture Theatre, Ltd., had taken the position and proposed to build a kinema, restaurant and offices. That idea also fell through, and now the railway company intimates that a seven-storey building is to be erected at a cost of £750,000, which will have a floor area of about ten acres, contain 200 flats, a big department store, shops, bank and a public hall.

Level-Luffing Jib Cranes.

By EDWARD G. FIEGEHEN, M.I. Mech. E.

No. I.

Mechanisms for varying the radius of jib cranes, by altering the angle of the jib to the horizontal, may be divided into two classes:—"derrick"—or jib-adjusting—gears, and "luffing" gears. In the former class, an occasional adjustment of radius, to suit the weight or position of the load, is the only

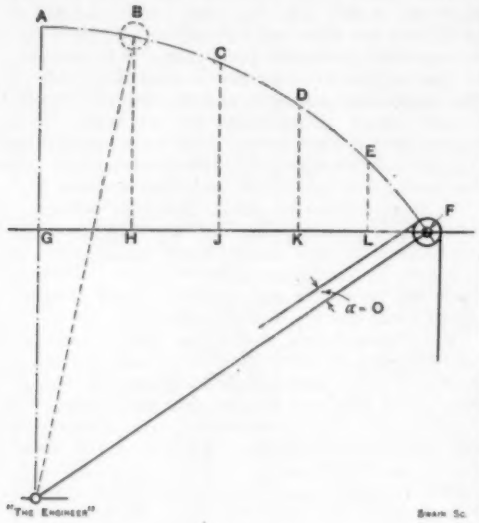


FIG. 1

object sought, whilst in the latter, the radiating movement of the jib, in the vertical plane, is in constant use, for the purpose of providing a radial translation of the load, at high speed and efficiency, to supplement the slewing and travelling motions of the crane.

Variation of radius has the advantage of materially increasing the area served by the crane hook and this is most valuable in the fixed type of crane, for in that case, when no jib-adjusting arrangement is fitted, the path of the hook is limited to the circumference of a circle of fixed radius, whereas, if the radius can be varied, the hook is able to serve the annular area enclosed between the circles of maximum and minimum radius. In many applications this advantage alone is sufficient to justify the cost of "derrick" gear, but when "luffing" gear is provided, particularly when it is arranged to ensure a horizontal translation of the load and to be capable of operating at high speed and efficiency, then many additional advantages are secured to which reference will be made later.

A broad distinction between "derrick" and

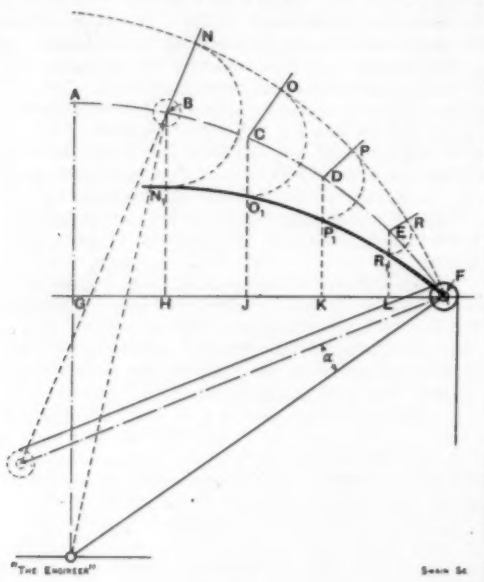


FIG. 2

"level-luffing" gears may be made by stating that, in the former, the variation of radius results in a simultaneous vertical movement of the load—in one direction, the rise of the load absorbs power, whilst the fall of the load, when derricking "out," necessitates adequate sustaining features in the derrick gear. In the latter type, the load is constrained to move in a horizontal path, having no tendency to rise or fall, and consequently no corresponding expenditure of power or necessity for restraint exists.

The fundamental requirements for "level luffing" with radiating jibs are the same throughout, and are illustrated by the following diagrams:—

Fig. 1 illustrates the extreme case in which the hoisting rope runs alongside or closely parallel to the axis of the jib. It is clear that, in this example, when the jib radiates, there will be no tendency for the hoisting rope to pay out over the jib head sheave, and that therefore the movement of the load will correspond closely to the arc A C F traced out by the jib head sheave pin and the rise of the load, starting from the inner radius, will be measured by the ordinates B H, C J, D K, E L. The energy required to raise the load in this manner, whilst derricking, must be supplied by the derricking motor, in addition to its primary duty of raising the jib. The fall of the load, when increasing radius, must also be controlled by the derricking gear and a corresponding amount

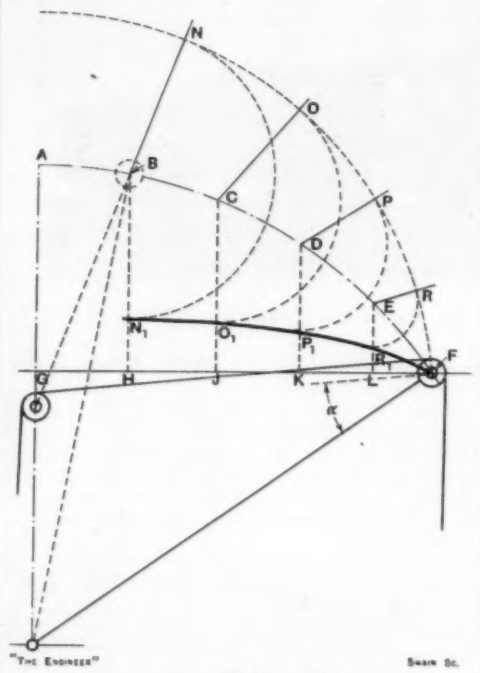


FIG. 3

of energy must be wastefully absorbed by braking devices.

In cranes of the locomotive type, the angle between the hoisting rope and the jib axis—α in Fig. 2—is still comparatively small, and it will be seen that, in consequence, much additional duty is thrown upon the derricking gear, due to the appreciable rise and fall of the load. Except in special cases, the derrick motion of such a crane is not designed to operate with the maximum load suspended, but is looked upon primarily as a radius-adjusting gear. More use is made of the travelling motion of this class of cranes than is possible in connection with cargo-handling

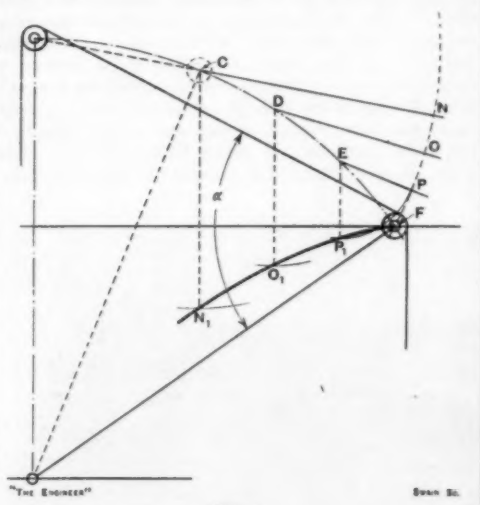


FIG. 4

cranes, and, consequently, the need for level-luffing gear is not very great; in fact, it is rarely fitted.

It is clear from an inspection of Fig. 2 that the resultant of the hoisting rope tensions will fall below the jib axis, producing a turning moment that must be resisted by the derrick gear and, consequently, non-reversible worm gearing is commonly employed for operating the derrick motion of this class of cranes.

It can be shown that in all level-luffing arrangements the resultant of the hoisting rope tensions passes through the jib axis and there can therefore be no tendency for the jib to rotate. Regarding G F—Figs. 1 and 2—as the desired horizontal path of the load, then the length of the vertical ordinates B H, C J, D K and E L indicates at each point the vertical compensation to be provided to secure a horizontal load path.

Fig. 3 indicates the conditions in the familiar "Scotch" derrick crane, in which the height of the mast is generally about half the length of the jib and the guide pulley for the hoisting rope is arranged near the top of the mast. It will be seen that in this example, owing to the increase in the angle α between the hoisting rope and jib axis, much less compensation—ordinates N_1 H, O_1 J, P_1 K, R_1 H—is now required to secure a horizontal path for the load. In the arrangements shown in Figs. 2 and 3 we have, in fact, secured a certain amount of compensation by the position of the hoisting rope guide pulley alone.

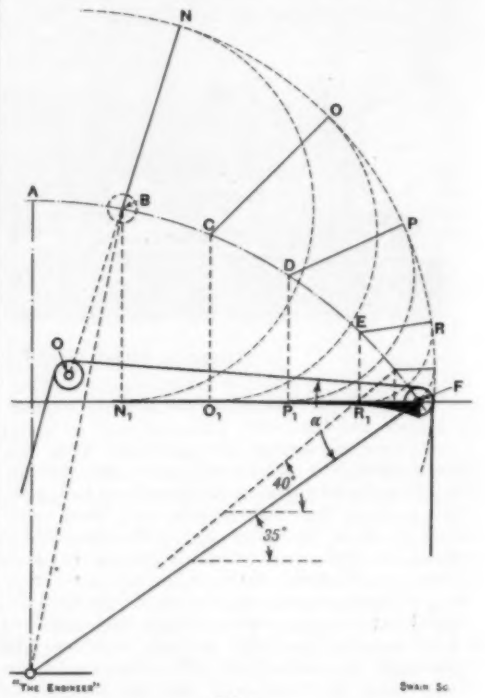


FIG. 5

In Scotch derrick cranes it has been usual to gear together the hoisting and derrick barrels, when varying the radius, so that they may rotate in unison, the hoisting rope being paid out whilst the derricking rope is coiled up to reduce the radius. Owing to the shape of the curve N_1 O_1 P_1 R_1 F, it is clear that a constant ratio between the speeds of the hoisting and derricking ropes will not effect correct compensation, but, by the expedient of fitting a "fusee" barrel of suitable contour for coiling the derricking rope, this may be overcome and, so fitted, this type of crane is seen to be the prototype of modern level-luffing cranes. As usually constructed, the hoisting and derricking motions, of such a crane, are not adapted for independent operation, the aim of the designer being merely to secure facility and convenience when derricking. In order to reduce the cost of production, most modern derrick cranes have a parallel derrick rope barrel, and the path of the hook consequently departs from the horizontal, but the approximation is considered sufficient for the duty expected from these cranes.

Having observed the improvement in load path effected by raising the axis of the hoisting rope guide

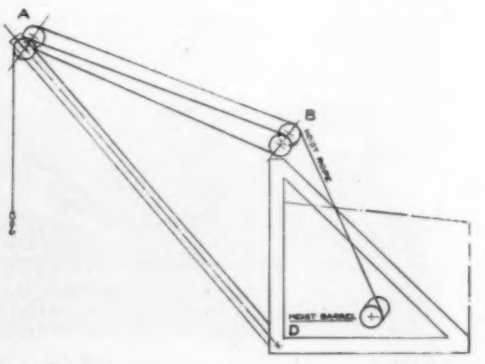


FIG. 6

pulley, we may go a stage further, and locate it, for instance, at a height above the jib axis equal to the length of the jib, as in Fig. 4. It is now seen that the load, instead of rising as before, actually falls, as the radius is decreased, and the arrangement is consequently unstable and impracticable in the form assumed, it being clear that the guide pulley is now too high.

Fig. 5 indicates a method of placing the guide pulley to give a very fair approximation to level luffing, without the use of any subsidiary arrangements. From successive positions B C D E F of the jib head, draw arcs outwards, having a radius

in each case equal to the vertical compensation ordinate to the horizontal at that point. Now find a point O by trial, from which an arc N P R may be described touching these arcs as fairly as possible. If the hoisting rope guide pulley be situated at O—which falls about 0·63 jib length above the jib foot pin and about 0·07 jib length in front of the vertical through that point—then the overhaul of the hoisting rope, when decreasing radius, will be such as to constrain the load to traverse the path $N_1 O_1 P_1 R_1$,

FIG. 7

which approximates very fairly to the horizontal, for jib angles not less than, say, 40 deg. to the horizontal. "Mannock's" level-luffing gear is based on this principle, and is undoubtedly the simplest yet devised.

At this stage it will be convenient to divide level-luffing gears into five main groups, as under:—

Class A—Figs. 5, 6 *and* 7.—These cranes depend upon hoisting rope guide pulley position and hoisting rope arrangement alone for compensation. To this

FIG. 8

class belong "Mannock's" gear, just described, the original "Toplis" gear and the "Bowtell" gear, both to be described later.

Class B—Figs. 3 *and* 8.—In these cranes, a horizontal path for the load is secured, partly by hoisting rope guide pulley position and partly by gearing or the equivalent. The classical example in this group is the Scotch derrick crane, fitted with a fusee luffing barrel, and it also includes the "Watkins" gear and that form of the "Bowtell" gear in which a two-diameter luffing barrel is used.

Class C.—Here compensation is secured partly by hoisting rope guide pulley position and partly by linkage. One of the oldest gears—the "Mitchell-Williams"—belongs to this class, which also includes the recent "Toplis (1925)" gear and the "Mitchell" gear.

Class D.—Here the compensation secured by guide pulley position is supplemented by the compensating effect obtained by attaching the tail of the hoisting rope to the luffing barrel. This method has been

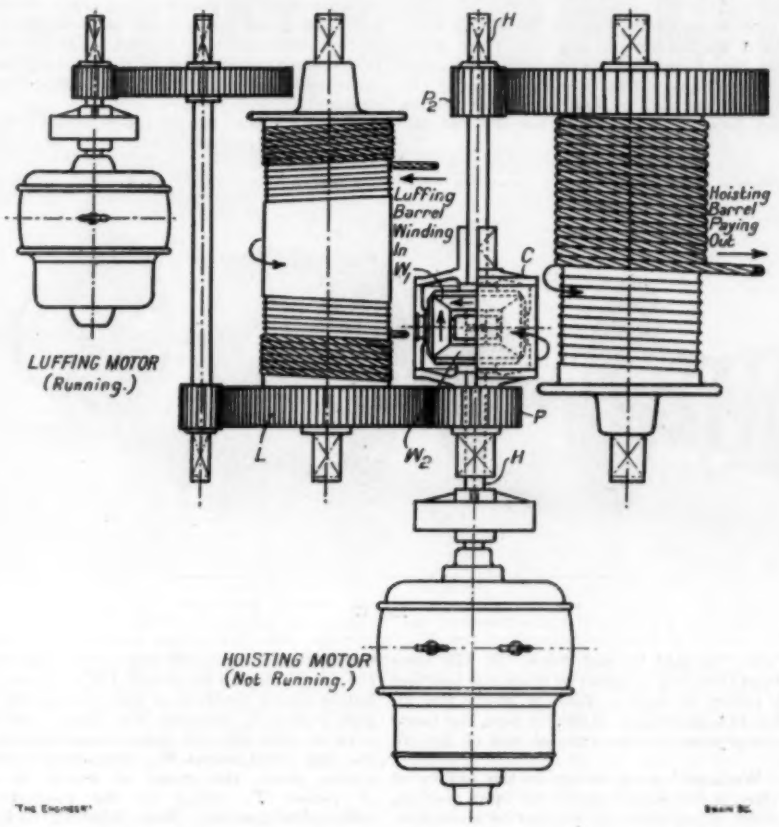


FIG. 9

developed independently by Toplis and by the present writer. Obviously, such a method is only applicable to cranes working with a snatch block for lifting.

Class E.—This class secures level luffing by adjusting the height of the jib head pulley to give the necessary compensation. The "Babcock and Wilcox" gear and the "Jardine" gear belong to this group.

We now propose to consider, first, the arrangements adopted in the above classes to secure the desired end, and, secondly, the question of counterbalancing the deadweight of the jib and the arrangement of jib-operating mechanisms.

Class A: Stothert and Pitt Gear.—Made by Stothert and Pitt, Ltd., Bath. The principle of this gear is illustrated by Fig. 6, in which for clearness the luffing ropes and gearing—which merely radiate the jib and take no part in compensation—are omitted. The hoisting rope guide sheaves are arranged vertically above the jib foot pin D, at such a height D B that the shortening of the line A B is exactly one-third of the vertical rise of the jib head sheave A, and therefore by reeving the hoisting rope in three parts between A and B the three-fold overhaul obtained causes the hook to rise and fall to the full extent, at each point, required for compensation and a horizontal path for the hook is ensured without any additional compensating mechanism.

It will be noticed that no reverse bends are formed in the hoisting rope, and that, owing to the great distance between A and B no portion of the rope is required to pass over more than two pulleys, even on fairly long lifts. Both these features are of importance, since they tend to secure long life for the hoisting rope, and that advantage, added to the extreme simplicity of the arrangement generally, have no doubt contributed materially to the popularity and wide application of the gear.

Class A: Bowtell Gear—Fig. 7.—Made by Ransomes and Rapier, Ltd.; Ipswich. In this gear compensation is secured by altering the length of a bight of the hoisting rope, a feature that will be seen to be common to many gears, including the "Toplis" gear just described—which, however, differs to the extent that three parts of hoisting rope are concerned. In the "Bowtell" gear the necessary adjustment of the

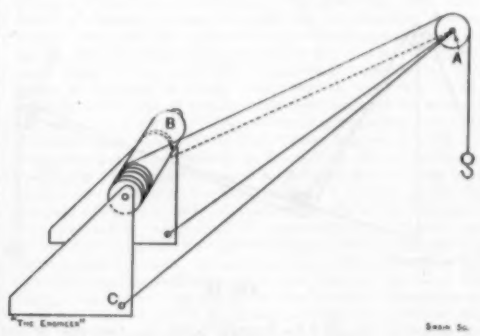


FIG. 10

length of this bight is secured with the assistance of the luffing gear, and consequently the hoisting and luffing gears are here interdependent in producing the compensating effect.

Referring to Fig. 7, we see that the hoisting rope, on its way from the barrel, passes around a guide pulley A placed slightly behind the jib foot pin—to allow for lappage—thence over a movable compensating pulley B, back around another pulley on the same axis as A, and then along the axis of the jib to the jib head pulley on its way to the hook. The movement of the guide pulley B is controlled by the luffing ropes, which are secured to its carriage, and pass thence around guide pulleys E—guide pulleys D—to the jib head. In this gear the guide pulleys D are arranged at such a height above the jib foot pin that the distance D F varies, in some direct proportion—

in this case 1 to 2—with the vertical movement of the jib head, consequently, the connection being direct, the guide sheave B moves in the same proportion and pays out or pulls in hoisting rope to the extent of twice its own movement, which is what is required for complete compensation. In this hoisting rope arrangement there will be seen to be one reverse bend—at the jib head sheave—but its distance from the other bends is so great that it cannot be regarded as detrimental. In the luffing ropes there is a reverse bend at D, but in this instance the rope speed is very low.

Class B: Watkins Gear—Figs. 8, 9, 10 *and* 11.—Made by John M. Henderson and Co., Ltd., Aberdeen. This gear resembles the Scotch derrick type in so far as compensation is secured partly by hoisting rope pulley position and partly by gearing together the hoisting and luffing barrels, but the

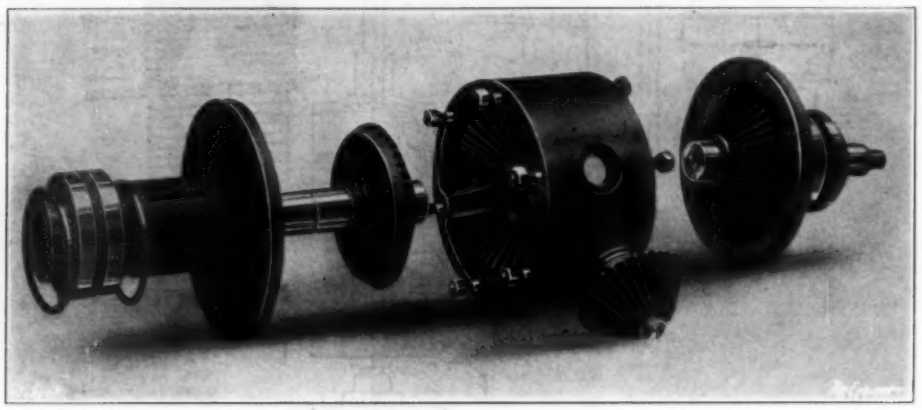


FIG. 11

similarity may be said to end there. It will have been observed that it is possible to place the hoisting rope guide pulley at such a distance above the jib foot pin that the shortening of the tie rope line bears a definite proportion to the vertical rise of the jib head pin.

In the "Watkins" gear, owing to the ability of obtaining part of the compensation by spur gearing, this proportion is conveniently decided by considerations of economic construction and is generally determined somewhere between 3 and 5, according to the type of crane. In the crane illustrated by Fig. 8, the shortening of the tie rope line bears a proportion of 1 to 3¾ to the vertical rise of the jib head pin.

Fig. 10 is a diagrammatic sketch which, it is hoped, will make the general principles of the Watkins gear clear. A barrel B is fitted at the correct position above

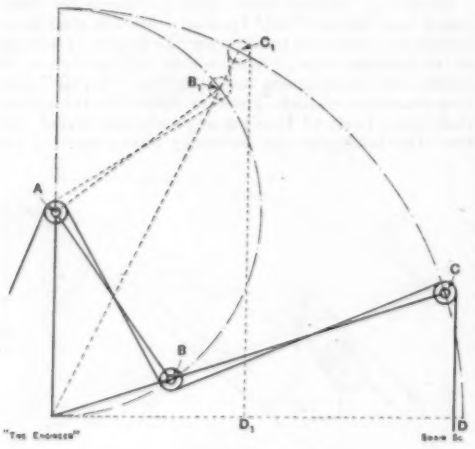


FIG. 12

C to give, say, a 2 to 1 ratio between the rise of the jib head pin and the shortening of the distance B A. The hoisting and luffing ropes are coiled around this barrel in opposite directions and both lead to the jib head, to which the luffing rope is secured, whilst the hoisting rope passes over a sheave to the hook in the usual way. It is clear now that, as the barrel rotates, the hoisting rope will be paid out to the same extent that the luffing rope is wound up, and *vice versâ*.

Since the ratio between the rise of the jib head pin to the shortening of the tie rope line is 2 to 1, half the required compensation is thus provided mechanically, and the other half provided by the position of the barrel.

In an actual crane such as that now described the hoisting and luffing barrels are separate and capable of independent operation; the barrels are also conveniently arranged on a lower plane.

Watkins secures independence of action for the barrels by means of the familiar differential gear, as depicted in Fig. 9. It will be seen that the hoisting pinion shaft H is in two parts, divided in the centre of the differential gear-box. Each half of the shaft is keyed to a "sun" bevel wheel W_1 and W_2, whilst the "planet" bevel pinions are journalled on studs, secured to the casing, which latter is bushed to run free on the two ends of the hoisting pinion shaft, and is also provided with its own journal bearings. To the casing is keyed spur pinion P, which gears with the luffing barrel wheel L, and consequently is held stationary when the latter is at rest. Under these circumstances the planet pinion studs are also stationary, and these pinions act as connecting gears for motion between the divided ends of the hoisting pinion shaft, which enables the hoisting motion to be operated independently of the luffing motion, as is essential.

Turning now to the operation of the luffing motion, we will consider the hoisting motor—and consequently the connected sun bevel wheel W_2—at rest. When the luffing barrel revolves, it also rotates the differential gear casing C, carrying the planet pinions around with it, and they, in turn, communicate motion to the sun bevel wheel W_1, connected to the hoisting pinion shaft, the speed of which is twice that of pinion P, owing to the properties of the differential gearing. Now, referring to Fig., 10 it is seen that we require the hoisting barrel to revolve at the same rate as the luffing barrel—assuming equal diameters and single part ropes—and consequently, in this modification, we arrange a ratio of 2 to 1 between the spur pinions P and P_2. The same result can be secured by providing a ratio of 2 to 1 between barrel diameters, or it can be secured by a combination of the above expedients. Fig. 11 shows the differential gear used, the parts having been separated for clearness.

Class C: Mitchell-Williams Gear—Fig. 12.—Made by John M. Henderson and Co., Ltd., Aberdeen. This is one of the oldest gears, and is a fine example of the direct application of a geometrical principle. Referring to Fig. 12, the axis A of the hoisting rope guide pulley is arranged half a jib length above the jib foot pin. From the point B swinging links, also half a jib length, connect to a guide sheave trolley B running along the axis of the jib. Leaving the barrel, the hoisting rope passes first over a sheave at A, thence under the travelling guide sheave at B, afterwards passing up the axis of the jib and over the jib head sheave C to the hook. Draw the arcs C_1 C and B_1 B. It can now be shown geometrically that the sum of such lengths as B C and C D is constant, for all positions of the jib between the horizontal and vertical, and, since the radius A B is also constant, it is evident that the path of the load will be a horizontal line.

It may be remarked here that for jib angles less than 35 deg. to the horizontal many of the gears described in these articles are unsuitable, but it will be seen that the action of the present gear is geometrically correct throughout the quadrant.

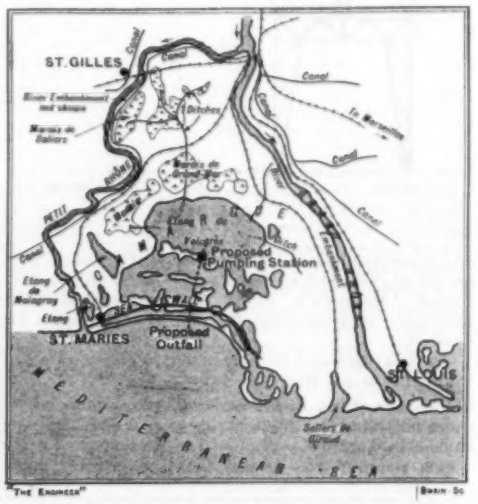
(To be continued.)

The Drainage and Irrigation of La Camargue.

At Arles the river Rhone divides into two arms, the Grand Rhône forming the eastern and the Petit Rhône the western boundary of the delta. The area enclosed by the dykes built alongside these arms and the sea wall along the shore is 75,000 hectares, or 185,000 acres, in extent. Of that area, some 56,000 hectares, or 138,000 acres, will be affected by some irrigation and drainage works which are now proposed, 40,000 hectares, or 98,800 acres, of the area being now saline or marshy tracts, and the remainder under cultivation. The measures proposed are based in part upon a study of irrigation in Lower Egypt, where the conditions, it is considered, are in many respects similar to those in the Rhone delta, including the southern portion, known as La Camargue.

These matters were discussed in an article published in a recent issue of *Le Génie Civil*, but for the present purpose attention may be mainly directed to the description of conditions in the delta which are of some interest to engineers concerned with works of reclamation and irrigation.

The two branches of the river have behaved in the manner usual under the conditions, the coarser silt, dropped during the later stages of sharp spates, having been deposited alongside their channels, thus raising the ground level, while finer silt has been more thinly spread further afield. Moreover, since the dykes were built the rivers have been raising their beds for a hundred years or so, and now "command" the delta, or the lower parts of it. Meantime, as was the case in the earlier history of the delta, the prevailing currents, which are from east to west, have been transporting material from the mouth of the Grand Rhône, dropping it along the shore of La Camargue, and so creating salt lagoons, the oldest of which have received sufficient water from spates of the Rhone to change them into fresh-water meres. Passing from the northern edge of La Camargue to the coast, there is a succession of ancient littoral belts, or beaches, witnesses of the progressive retreat of the sea as the delta asserted its allegiance to the land. Between these belts there are lagoons or meres, the largest of which is that of Valcarès. The lands north of La Camargue, as well as the old beaches and the silt-fed strips bordering the Rhones, are, for the most part, 1·50 m., or 4·92ft. above sea level, or somewhat higher, the soils being light and sandy. These constitute the 1600 hectares now cultivated. Those alongside the two branches of the river are watered by means of pumping stations set at intervals. The lagoons are at sea level, or a little below it, and the lands adjacent to them, which are irrigated directly from the Rhones, are described as being partly converted into rough grasslands and yielding a small return for very little labour. The rest of La Camargue consists of large saline marshes which yield only wild vegetation. Since 1870 the upper part of La



MAP OF LA CAMARGUE DISTRICT

Camargue has been drained by five large ditches, which empty into the Valcarès lagoon.

All the Camargue lands are poor in nitrates, but are rich in potash and contain a fair proportion of carbonates; they are considered to be good lands, comparable with those of Lower Egypt and capable of yielding satisfactory crops if the excess of salt be removed. They are now, however, heavily charged with salt, as the result of repeated immersions and continued evaporation in a dry climate. The annual evaporation amounts to 1·5 m., or 4·92ft., while the rainfall is only ·5 m., or 1·64ft. Therefore, 1·0 m., or 3·28ft., of sea water enters every year and leaves behind it the Mediterranean quota of salts.

Here a digression may be permissible for the purpose of citing figures which seem to bear upon the case. Noting that the climate of California is drier than that of the Bouches-du-Rhône, the second table on page 1427 of Kempe's "Engineer's Year Book," 1927, may be consulted. This shows that with the temperatures, air in shade 76 deg., soil in shade 78 deg., soil in sun 108 deg., and when the soil contained 8·9 per cent. of water, the evaporation from the soil was at the rate of 3·8ft. in a year, while that from a water surface was at the rate of 8·3ft. in a year.

The project now under consideration is estimated to cost about 10,000,000f. It is proposed to maintain the water level of the Valcarès lagoon, the natural sump of the area, at 0·5 m., say, 19in., below low tide level, by means of an 800-kilowatt pumping plant at Mornès on the south bank of the lagoon, the water being pumped into a channel leading to the sea. This channel will be 6 kiloms. in length, 125 m. bed width and 1·0 m. water depth. The water will reach the pumping station by a channel 1·0 kilom. in length, 40 m. bottom width and 1·0 m. water depth. It is estimated that the plant will during the autumn rains have to pump 32,000,000 cubic metres in three weeks, or nearly 18 mecusecs, provision being made for 20 mecusecs.

The scheme seems to promise good results, especially if the land be used for feeding cattle for a considerable period before the more saline areas are put under the plough.

Obituary.

WILLIAM EDWARD HARDY.

WE regret to hear of the death, in Vienna, on the 15th inst., of Mr. William Edward Hardy, whose name is known, the world over, as the inventor of the Clayton-Hardy vacuum brake for long goods trains.

Mr. Hardy was the son of Mr. John Hardy, of Gateshead-on-Tyne, and was born on October 10th, 1859. In his early youth he went with his father to Vienna, and eventually became the President of the well-known engineering firm of Gebruder Hardy of Vienna. In 1906–7 he conducted, with remarkable success, the trials of the Clayton-Hardy brake on gradients of 1 in 33 on the Arlberg section of the Austrian State Railways, which were witnessed not only by the Austrian Imperial Railway Administration but by eminent railway engineers from England, India and continental countries. Those trials showed that by the use of this invention automatic continuous vacuum brakes were practicable on long goods trains. The adoption of that brake by the Austrian Government led to the question being considered by *L'Unité Technique* in Berne, which body conducted some further interesting and satisfactory tests in 1912. The results obtained on those and other occasions were recited by Mr. Hardy when he spoke at the Institution of Civil Engineers on January 10th, 1922, during the discussion on the paper by Sir Henry Fowler and Mr. H. N. Gresley on "The Vacuum Brake for Long Freight Trains."

Mr. Hardy was, in 1908, elected a director of the Vacuum Brake Company, Ltd., which position, together with that of the company's European representative, he had held continuously since. He was a life member of the Institution of Mechanical Engineers, and had taken out many interesting patents in this country and abroad.

WILLIAM HENRY WHITING.

IT is with regret that we have to record the death of Mr. William Henry Whiting, C.B., late Assistant Director of Naval Construction at the Admiralty. Mr. Whiting was born in 1854 and entered Portsmouth Dockyard as a shipwright's apprentice in 1869. Four years later he became a student at the Royal Naval College, Greenwich, and in 1876 he left Greenwich and returned to Portsmouth as an assistant supernumerary draughtsman. When the Royal Corps of Naval Constructors was formed in 1883 Mr. Whiting was entered as a second-class constructor, and in such a capacity he returned to the Admiralty. In 1885 he was appointed instructor in Naval Architecture at Greenwich College, where he spent five years before going back to the Admiralty. Mr. Whiting was appointed Constructor at Chatham Dockyard in 1890, and later spent twelve months at Devonport. From Devonport he was appointed to Hong Kong in 1895, and in 1897 he was made Chief Constructor at that yard. He returned to the Admiralty as a Chief Constructor, and was later appointed Assistant Director of Naval Construction. In 1912 he became the Superintendent of Construction Accounts and Contract Work at the Admiralty, which office he held until his retirement in 1917. Mr. Whiting was a member of several departmental committees at the Admiralty, and in 1912 acted as technical assessor at the court of enquiry which investigated the loss of the first British rigid airship, known as the Mayfly. He was elected a Vice-President of the Institution of Naval Architects in 1916, and was a member of the Council of that body. Always a ready speaker in discussions, Mr. Whiting contributed a paper himself at the spring meetings of 1903, on "The Effect of Modern Accessories on the Size and Cost of Warships." He was also a member of the Institution of Civil Engineers.

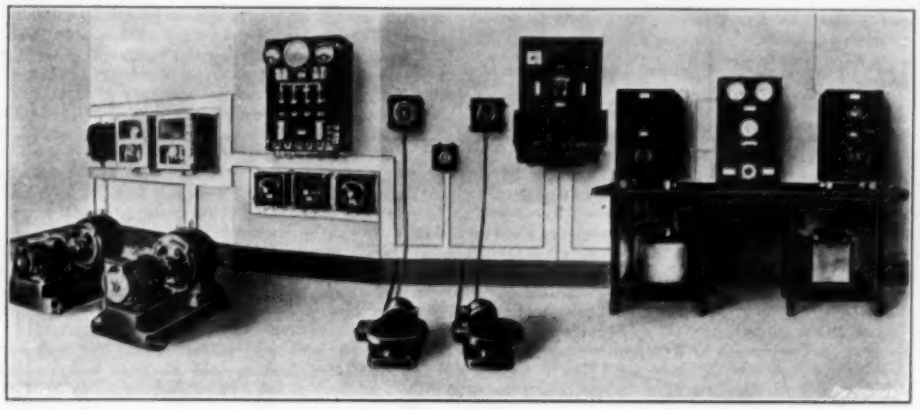
The Round Island Wireless Beacon Station.

FOR assisting navigation at various points around the English coast wireless beacons are now being constructed by Trinity House. It is well known that the object of these beacons is to send out distinctive wireless signals at regular intervals so as to enable vessels fitted with wireless direction finders to take bearings on the beacon stations and accurately to determine their positions. The first wireless beacon station to be put into operation is situated on Round Island, one of the Scilly group. The installation has a power of 500 watts and it is operated on a wave length of 1000 m., which is the specified wave length for wireless beacon stations. Each station is to have a special call sign, and at Round Island the sign is GGG in the Morse code. The beacon transmitter, which was designed by the Marconi Company to the specifications of Trinity House, is automatically controlled by a master clock so as to transmit groups of I.C.W. signals at predetermined intervals. Every possible precaution has been taken to avoid breakdown of the apparatus, and the running machinery and other equipment are duplicated.

A view of the aerial and lighthouse is given below while above is seen the transmitting apparatus. A steel lattice tower mast 60ft. high supports a multi-wire aerial of the L type, the aerial being suspended between this mast and the lighthouse gallery at a height of about 50ft. Referring to Fig. 2, on the extreme left there is the main switch and two automatic starters. Below these starters the motor alternators are to be seen. Next to the automatic starters is the main switchboard, with three field regulators beneath it. To the right of the main switchboard are the two speedometers or revolution indicators for the character wheel motors, the character motor field regulator being mounted just below and between these indicators. On the floor immediately under the regulator are the duplicate character motors with their character wheels, which form the automatic signalling key for the transmitter. To the right of the indicators is the character switchboard, which carries two master control clocks, that automatically start and stop the transmitter at specified intervals. The table on the extreme right carries the wireless apparatus, the three instruments on the table being the closed circuit inductance, the oscillation generator containing four valves, two of which are spare, and the aerial inductance. In the left-hand cupboard is the closed circuit condenser and in the right-hand cupboard the power transformer. Chokes, condensers, resistances, and variometers are, of course, provided. All the four valves are of the T250 type, two being standby valves. In the event of either of the two valves burning out a relay mounted on the panel immediately brings the other pair of valves into use and at the same time a loud speaker alarm circuit is completed. The valve filaments are heated by means of a step-down transformer supplied by the main alternator. The transmitter circuit is that commonly known as the back-to-back circuit, the note actually heard in the receiver corresponding to a frequency twice that of the alternating current frequency. The transmitting unit itself is enclosed by an expanded metal case, rubber matting being provided to avoid risk of shock. The high-frequency apparatus provides for coupled circuit working and consists of two cabinets, one of which contains the tuning inductance, variometer, coupling coil and aerial ammeter, whilst the other contains the closed circuit inductance, reaction coil, closed circuit condenser and closed circuit ammeter. The high-frequency apparatus is designed to work efficiently on a wave length of 1000 m.

500 WATT WIRELESS BEACON STATION EQUIPMENT

MARCONI'S WIRELESS TELEGRAPH CO., LTD., LONDON, ENGINEERS



LIGHTHOUSE AND WIRELESS MAST ON ROUND ISLAND

The signalling apparatus consists of two main parts, the master control clock, which determines the periods when the beacon is to come into operation, and the character wheel, which transmits the call sign of the station. The duplicate master clocks are mounted on a switchboard which also incorporates a relay operated by the clock for starting up the motor driving the character wheel. The signal for fair weather periods consists of the call sign GGG repeated at the rate of fifteen words per minute for forty-seven seconds followed by a prolonged dash of ten seconds duration and terminated by one repetition of the call sign, the whole transmission taking sixty seconds. This transmission, followed by a silent period of three minutes, in each case is repeated three times, covering a total of nine minutes every half-hour. This sequence is carried out in the following manner. Just prior to the beginning of the transmission, contacts on the clock start up the main alternator, which provides the whole of the power required for the transmitter. A small pair of contacts then energises the motor of the character wheel. At the end of the third transmission the clock contact opens and the circuit of the main alternator is broken until the next half-hour period is required. In fair weather the cycle is repeated every half-hour. In foggy weather a hand-operated switch is turned to short circuit the alternator contacts and the whole signal, consisting of the one-minute transmission and three minutes' silence, is then repeated continuously. In addition to the clock switchboard mentioned, switchboards are provided for the main power plant. These switchboards contain all the necessary switches, &c., for controlling the machinery.

Each motor alternator consists of a shunt-wound 1¼-kW direct-current motor designed to run on a 50-volt supply and coupled to a separately excited 100/150-volt, 400/600-cycle, single-phase alternator, mounted on a common bed-plate. Field regulators and automatic starters are also provided, and the frequency of the alternating current can be varied within the limits of 400 and 600 cycles.

A battery is provided which is capable of running the complete station for a period of twelve hours without recharging. For charging the battery there is an automatic charging plant, which starts up the engine, and it commences to charge the cells as soon as the battery volts drop to a predetermined value. Immediately the voltage of the battery reaches the proper value the engine is automatically switched off. A feature of the charging plant is that the line voltage is kept constant and the automatic control switchboards are arranged so that at every charge the engines are used alternatively. If one engine fails to start, after a few seconds the battery is automatically switched on to the dynamo belonging to the other engine, and if that engine should also fail to start, the plant switches itself off and rings a bell to warn the light keeper.

With a normal direction-finding ship's receiver the station is capable of giving accurate bearings up to from 70 to 100 miles, but under favourable conditions this range can be considerably increased.

SIXTY YEARS AGO.

IN our issue of August 23rd, 1867, we find it reported that Isaac Baven, of Redhill, had been summoned for driving in the public streets of Guildford a traction engine not constructed so as to consume its own smoke. In dealing with the charge the Mayor of Guildford said that it was a very serious inconvenience to the inhabitants to have thick smoke sent into their houses through their windows, which at that time of the year were generally kept open. For the defence it was argued that no traction engines were constructed to consume their own smoke as required by the Act of Parliament governing the matter, that none were likely to be constructed, and that there were other forms of locomotive which came within the limits of the borough which failed to consume their own smoke without incurring a penalty. In spite of these arguments, however, the defendant was fined for his offence 5Cs. with costs. It may surprise some readers to learn that the requirement governing the consumption of its own smoke still has legal force in the running of a locomotive. Not so long ago the Southern Railway and the London, Midland and Scottish were separately summoned for operating engines not constructed to consume their own smoke. In one instance, if we remember aright, the prosecuting authority succeeded in obtaining the infliction of a fine, but in the other the defence succeeded on the plea that it was impossible to construct an engine in accordance with the terms of the Act. In the same issue Mr. Thomas Boulton, of Ashton-under-Lyne, made the claim that he had that week made the longest continuous run recorded as having been accomplished within twenty-four hours on a road locomotive engine. The route followed was from Ashton through Manchester, Eccles, Warrington, Preston Brook, to Chester and thence back to Ashton. The total distance covered was over 90 miles and the trip was accomplished "without a single mishap or stoppage for anything except to take in water." The engine was fitted with a single cylinder, 4¼in. in diameter by 9in. stroke, and worked with a steam pressure of 130 lb. It had 5ft. wheels, and for the most part carried six persons and at times even eight or ten. Eighty miles of the route followed covered roads entirely strange to all concerned, on which water had to be found when required as the journey proceeded. In a leading article in the same issue we criticised the common design of road locomotive or traction engine, chief objection being expressed to the universal practice of placing the cylinders, crank shafts, &c., on top of the boilers, a system which, we said, threw all manner of strains upon the boiler. The value of steam as a hauler on our highways would, we concluded, remain limited until traction engines were produced on the lines of the railway locomotive.

GRAPHICAL ANALYSIS OF STRESS

(For description see opposite page)

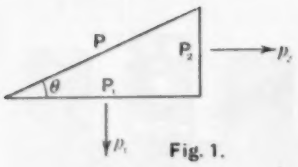


Fig. 1.

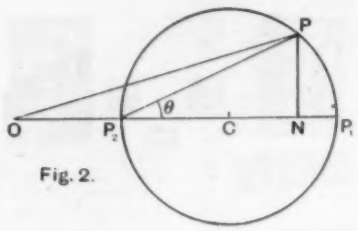


Fig. 2.

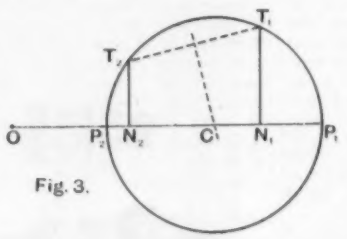


Fig. 3.

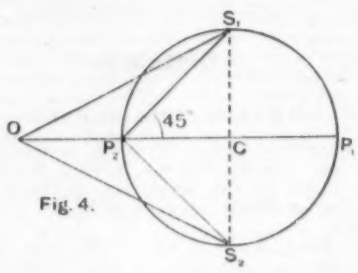


Fig. 4.

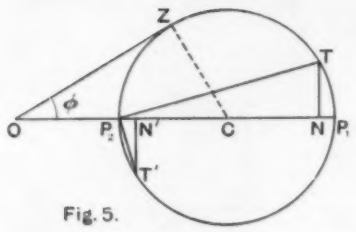


Fig. 5.

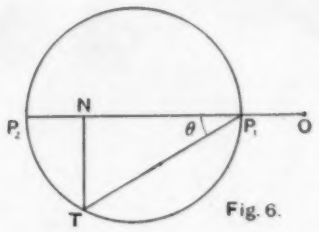


Fig. 6.

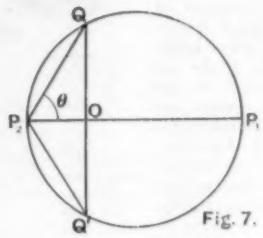


Fig. 7.

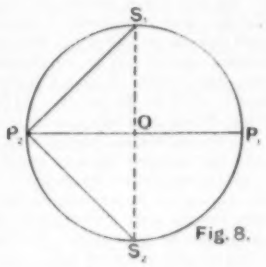


Fig. 8.

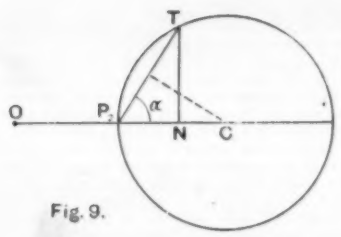


Fig. 9.

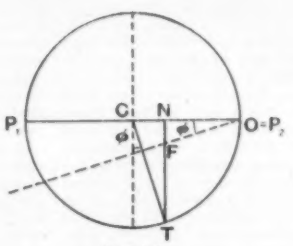


Fig. 10.

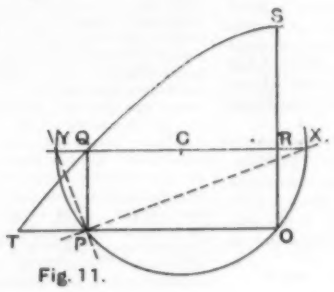


Fig. 11.

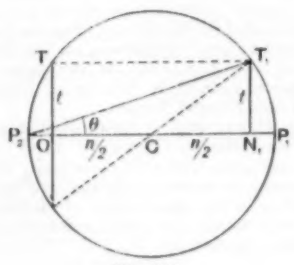


Fig. 12.

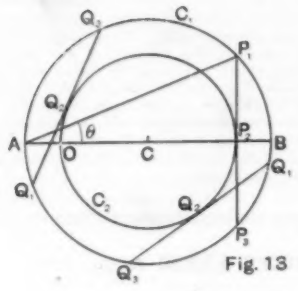


Fig. 13

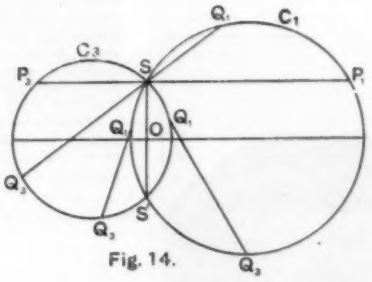


Fig. 14.

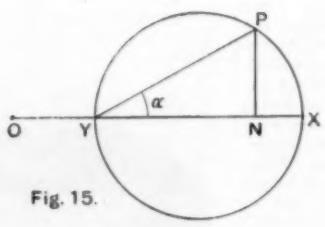


Fig. 15.

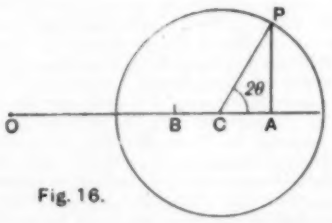


Fig. 16.

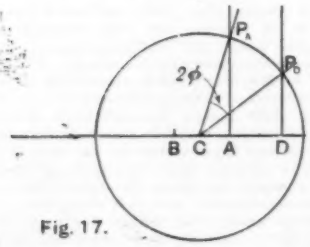


Fig. 17.

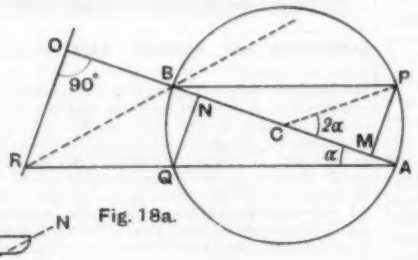


Fig. 18a.

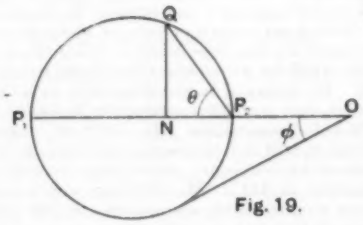


Fig. 19.

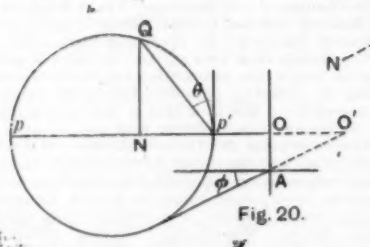


Fig. 20.

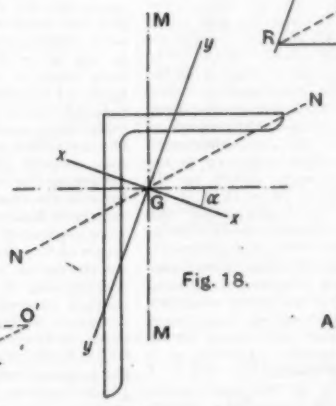


Fig. 18.

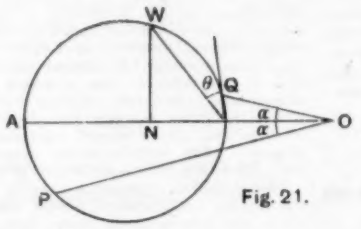


Fig. 21.

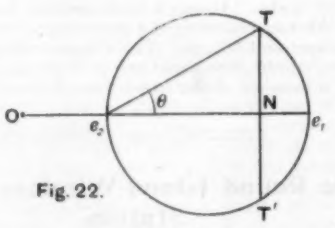


Fig. 22.

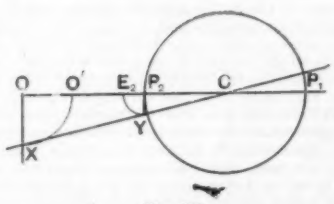


Fig. 23.

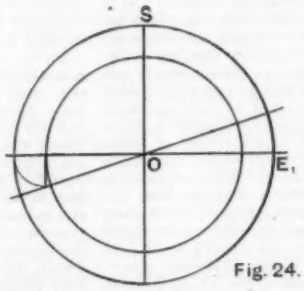


Fig. 24.

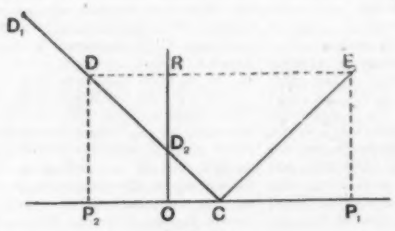


Fig. 25.

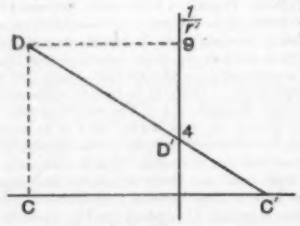


Fig. 26.

"THE ENGINEER"

SWAIN Sc.

A Graphical Analysis of Stress.

By H. W. SWIFT, M.A., B.Sc.

THE stresses to which a material is subject across the various planes passing through a given point are usually treated analytically in text-books and the mathematical work involved is somewhat laborious to students and does not always leave a clear impression of the real meaning of the results. The ellipse of stress to some extent helps to make these clear, but is a means of illustration rather than a useful construction.

In his recent Thomas Hawksley Lecture Professor E. G. Coker called attention to a graphical construction known as the Mohr diagram, which shows in a remarkably simple way the components of stress on the various planes through a point. This graphical construction is worthy of more attention than it seems to have received, for it not only demonstrates very clearly the relationship between and the changes in value of the normal and tangential stresses at a point; it also enables the treatment of stress geometry to be made more convincing and accessible to the student with limited mathematical powers, and it facilitates the solution of a number of problems which would otherwise involve lengthy analytical work. It is proposed in the present treatment to establish this construction in a modified form by a new method, in which the steps are so chosen as to permit of fairly simple demonstration to students. Following this an account is given of certain applications to which the construction seems to lend itself with advantage over the analytical methods which have been employed hitherto. The treatment is two-dimensional throughout.

The development is based on two simple propositions:—

(*a*) By considering the statical equilibrium of a triangular prism and resolving parallel and normal to any face P it is clear that the values of the normal and tangential components of stress on any such plane can be determined uniquely when the stresses are known across any two other planes through the point under consideration.

(*b*) Assume that a plane P_1—Fig. 1—can be found passing through the point under consideration across which the stress is purely normal. Then by a simple application of the principle of moments to a rectangular prism it is shown that the stress on the plane P_2 perpendicular to P_1 is also purely normal. Suppose that the normal stresses are p_1, p_2, respectively, being reckoned positive when tensile. Then by resolving forces in the usual way tangential and normal to a plane at any angle θ with P_1 we find that the components of stress on this plane are:

$$n = p_1 \cos^2\theta + p_2 \sin^2\theta,$$
$$t = (p_1 - p_2) \sin\theta \cos\theta,$$

t being measured clockwise.

Preserving the above notation, suppose we draw—Fig. 2—a base line from any origin O and on this line mark off to a convenient scale O P_1 to correspond to the stress p_1, and in the same direction—with the usual sign convention—O P_2 to correspond to p_2. On P_1 P_2 as diameter describe a circle. From P_2 draw P_2 P making any angle θ with the base line, and cutting this circle in P.* Then, if P N be dropped perpendicular on to P_2 P_1 and C is the centre of the circle, we have:

$$O N = O C + C N = p_1 \cos^2\theta + p_2 \sin^2\theta,$$
$$N P = (p_1 - p_2) \sin\theta \cos\theta.$$

Hence to the scale of the diagram O N represents the normal stress on the plane P, N P the tangential stress, and the vector O P the resultant stress. The angle of obliquity, usually denoted by φ, is P O P_1.

The diagram so constructed will cover all values of the angle θ, and therefore all planes through the point under consideration, the components of stress being in any case merely the co-ordinates of the point P obtained by drawing the chord P_2 P corresponding to the plane. It remains to be shown that the assumption upon which this construction is based—namely, that through any point a plane can be found across which there is no shear stress—is always true.

Suppose that the normal and tangential components of stress on any two planes through a point are known. Then by plotting these components—Fig. 3—as rectangular co-ordinates from an origin O, with the same conventions as before, the points T_1 T_2 can be found, representing the resultant stress on these two planes. By drawing a line to bisect T_1 T_2 at right angles a point C is determined on the base line O N_2 N_1, from which as centre a circle can be drawn passing through T_1 T_2. This circle is unique.

From the diagram it is clear that the stresses O T_1 O T_2 across two planes are *consistent* with the existence of a stress of intensity measured by O P_1 on the plane parallel to P_2 P_1 and a stress of intensity O P_2 on the plane perpendicular to this. But it has been shown that a knowledge of the stress across two planes determines uniquely that across any other, and it follows that the stresses on planes parallel and perpendicular to P_2 P_1 *must* be O P_1 and O P_2 respectively. Since, moreover, the points P_1 and P_2 are always real and determinate, two perpendicular planes can always be found which are subject to purely normal stress, and the diagram can therefore be applied in all cases.

A simple inspection of the diagram in the general case demonstrates at once certain well-known and important results:—

(1) Two planes—corresponding to P_1 and P_2—can always be found across which there is no tangential stress, and on these planes the normal stress, and indeed the resultant stress, has extreme values. In Fig. 2 O P_1 represents the maximum, O P_2 the minimum stress, and these correspond to the "principal planes" of stress parallel and perpendicular to P_2 P_1.

(2) The planes of maximum shear are clearly represented by P_2S_1 and P_2S_2 in Fig. 4, and make angles of 45 deg. with the principal planes.

(3) The tangential stresses on any two planes equally inclined to the principal planes have equal values.

(4) The tangential stresses on any two perpendicular planes have equal values—N T = N^1T^1 in Fig. 5.

(5) The sum of the normal components of stress across any two perpendicular planes is constant, and equal to the sum of the principal stresses—O N + O N^1 = O P_1 + O P_2 in Fig. 5.

(6) The maximum obliquity of stress φ is such that—

$$\frac{p_2}{p_1} = \frac{O C - C P_2}{O C + C P_2} = \frac{1 - \sin\varphi}{1 + \sin\varphi}$$

The diagrams employed above have referred to the case where the two principal stresses are tensile, but the reasoning and results are, of course, equally valid for other cases. When both the principal stresses are compressive the construction is of the type shown in Fig. 6. When one is tensile and the other compressive, the diagram takes the form shown in Fig. 7, and the results enumerated above can be verified. The planes across which the stress is purely tangential are clearly given by P_2Q and P_2Q^1, for which—

$$\tan\theta = \pm\sqrt{\frac{p_1}{p_2}}$$

For the special case in which the two principal stresses are equal in magnitude and opposite in sign, the origin O coincides with the centre of the circle, as in Fig. 8, and we have the state of "simple shear," with purely tangential stresses across the planes P_2S_1, P_2S_2. The diagram shows at once that this state is equivalent to tensile and compressive stresses—O P_1, O P_2—each equal in intensity to the fundamental shear stress—O S_1, O S_2—at angles of 45 deg. with the planes—P_2S_1, P_2S_2—of this shear.

The construction of the diagram to solve any problem concerned with the geometry of stress at a point may clearly be adapted to the demands of special cases.

When the principal stresses are known the construction has already been described. When the stresses across any two planes are known, the construction shown in Fig. 3 is applicable. It is to be noted that it is not necessary to know in advance the angle between these two planes, which can be found—$T_2P_2T_1$ in Fig. 3—as well as the directions of the principal planes. If the stress O T across any plane is known, together with the angle α between this plane and one of the principal planes, the diagram can be completed—Fig. 9—by plotting T and drawing T P_2 at the angle α with the base line. C is then found, the circle drawn and the principal stresses scaled off.

In applications of the diagram to stress problems the choice of the particular point—P_1 or P_2, Fig. 2—from which the chords are drawn is purely a matter of convenience, and no uncertainty will arise in constructing the diagram or interpreting the results, if the conventions are observed. Suppose, for example, P_1 is chosen. Then the chord P_1P is drawn, making the same angle—in sense as well as in magnitude—with the base diameter as the plane P makes with the plane P_2 in Fig. 1. Then the normal and tangential components of stress are the co-ordinates of the point P, shear being reckoned positive, *i.e.*, clockwise, when measured upwards on the diagram. If either principal plane, say, P_1, is horizontal, then chords drawn through the contrary point P_2 are actually parallel to the planes they represent, which is a convenience in operation. In any case the angular relationship between all planes is preserved.

APPLICATIONS OF THE DIAGRAM.

The following applications are some in which the graphical method seems to possess some advantage over the analytical, either in simplicity or clearness of presentation.

Let us consider in the first place the effect of friction on the resistance of a brittle material, such as cast iron, to simple compression. The stress diagram is shown in Fig. 10, and the shear stress on any plane parallel to P_2T, for example, is represented to scale by N T. This shear stress will be resisted partly by the shear strength of the material, and partly by the effect of intermolecular friction. If the limiting angle of this friction is φ, let O F be drawn, making the angle φ with O P_1. Then when the material is on the point of failing, the part N F (= O N tan φ) of the shear resistance on the plane P_2T will be due to friction, and the remaining part F T due to the shear strength of the material. Failure will therefore occur when the value of F T across any plane reaches its limiting value, and the plane across which this occurs will correspond to the point of contact T of a tangent to the circle parallel to O F. It is clear from the geometry of the figure that failure takes place across a plane P_2T inclined at $\frac{\pi}{4} + \frac{\varphi}{2}$ to the sectional plane P_2P_1—since P_1O T = $\frac{1}{2}$ P_1C T—and if S is the shear resistance of the material, the compressive stress at which failure occurs is $p = 2S \cdot \frac{1+\sin\varphi}{\cos\varphi}$

COMBINED STRESSES.

(1) The diagram suggests a simple construction to find the principal planes at any point in a beam subjected to shear as well as bending moment. Set out O T—Fig. 11—to represent the maximum tensile fibre stress due to bending, and draw T S to the same scale to represent the shear stress, due to the shearing force, at various fibres in the beam between the skin and the neutral axis. Since the distribution of tensile stress is linear across the section, O T may also be regarded as representing a part section of the beam, with neutral axis at O. From any point P on O T erect a perpendicular P Q to meet T S, and hence Q R to meet O S. With C, the mid point of Q R, as centre, draw a circle through P, O cutting Q R, produced in X, Y. Then P X, P Y are the principal axes of stress at the point corresponding to P, the length O C gives the maximum shear stress, and Q X, Q Y the principal stresses. The locus of C for various points P is a curve similar to S T, and for rectangular beams is parabolic. The maximum value of the shear stress occurs in this case, either at the neutral axis, if O S > $\frac{1}{2}$ O T, or otherwise at the skin. For a single concentrated load, this maximum will always occur at the skin T, except within a distance $\frac{d}{2}$ from either support, where d is the depth of the beam. It is curious that shear stresses due to pure bending, which usually are much more important than those due to shearing forces should receive so little attention in text-books.

(2) Under the conditions of combined bending and torsion in a circular shaft, the stress system at the point of the system furthest from the neutral axis is defined by a tensile component of intensity $n = \frac{32}{\pi}\frac{M}{d^3}$ across the radial plane and a purely tangential stress of intensity $t = \frac{16}{\pi}\frac{T}{d^3}$ across the perpendicular axial plane. The stress diagram is easily constructed from these data, as shown in Fig. 12, and the principal planes and stresses found at once, or, calculated from the geometry of the figures—

$$p_1 = O C + C T_1 = \frac{n}{2} + \sqrt{\frac{n^2}{4} + t^2} \qquad \tan\theta = \frac{t}{p_1}$$

The maximum shear on a plane at 45 deg with the principal plane, is similarly scaled or computed—

$$S = \sqrt{\frac{n^2}{4} + t^2}$$

and by substituting the values of n and t above, it is easily shown that the maximum tensile stress is the same as that due to the equivalent bending moment $\frac{1}{2}$ $(M + \sqrt{M^2 + T^2})$, and the maximum shear that corresponding to the twisting moment $\sqrt{M^2 + T^2}$.

(3) In connection with combined stresses, the diagram may be employed with advantage to trace the changes in stress which would occur across any plane during a cycle of variation in the applied load. Suppose, for example, that a shaft is submitted to torsion—shear stress S—together with a tensile stress n, either direct or by bending. Then the stress diagram—Fig. 13—takes the form of the circle C_1 and the maximum principal stress occurs on a plane inclined at the angle $\theta = \frac{1}{2}\tan^{-1}\frac{2S}{n}$ to the cross-sectional plane. If the torsional stress is removed, the diagram becomes the circle C_2, and, if reversed, the circle C_1 again.

The stress on the plane parallel to A P_1 was originally the vector O P_1. During removal and reversal of the torsional stress the vector head for this plane moves along the straight line $P_1P_2P_3$ to its final position P_3. It is a matter of simple geometry to show that the corresponding vector head for any plane, parallel to A Q_1, for example, moves along a similar straight line $Q_1Q_2Q_3$ tangential to circle C_2. The changes of stress on any plane in a shaft under constant tension, compression or bending—and submitted to reversals of torsional stress, are therefore represented graphically by a system of chords of the circle C_1 tangential to the circle C_2.

In a similar way, if the tensile stress be variable, from P_1 to P_3, and the torsion constant, so that the extreme circles are C_1 and C_3 in Fig. 14, then the vector heads for various planes move along the straight lines Q_1 Q_3, all of which are, or would be, concurrent at the point S.

UNSYMMETRICAL BENDING.

The Mohr diagram may be employed in place of the ellipse of inertia in problems of unsymmetrical bending.

The moment of inertia of the section of a beam about any axis through its centre of gravity, inclined at an

* The use of P_2 here proposed in place of C as the vector centre enables an exact angular relationship to be obtained between each plane and its corresponding vector, and opens up a number of channels of usefulness.

angle α to a principal axis x of inertia—defined by zero product of inertia—is given by—

$$I_\alpha = I_x \cos^2 \alpha + I_y \sin^2 \alpha$$

and the product of inertia for perpendicular axes—

$$\pi_\alpha = (I_x - I_y) \sin \alpha \,.\, \cos \alpha$$

Hence, if O X, O Y in Fig. 15 represent I_x and I_y respectively to scale, the length O N will represent I_α and the ordinate N P the product of inertia π_α.

Certain properties can be deduced at once from the diagram :—

(1) The principal axes, for which $\pi_{xy} = 0$, give maximum and minimum values for the moment of inertia.

(2) For any pair of perpendicular axes $I_\alpha + I_\beta$ = constant = 2 . O C = J, the polar moment of inertia.

(3) Any axis of symmetry is a principal axis.

(4) If there are more than two axes of symmetry the circle becomes a point and all values of the moment of inertia are equal.

The diagram may be constructed in various ways according to the data. If, for example, the values O A, O B of the moment of inertia are given for any two perpendicular axes, together with the angle θ, which one of these makes with a principal axis the construction consists in drawing—Fig. 16—from C, the mid point of A B, a line at an angle 2 θ with the base to meet A P in P. In the same way, if I_A, I_B and I_D are known, together with the angle φ between the axes A and D, P_A, P_D in Fig. 17 can be fixed by trial with a protractor centred at C in such a way as to subtend an angle $P_A C P_D = 2\varphi$.

The position of the neutral axis and the greatest stress intensity for a given bending moment can also be found by use of the diagram. Take, for example, an unequal angle—Fig. 18—for which the moments of inertia about axes parallel to the faces are known from tables together with either the angle which the principal axes make with these, or the value of the least moment of inertia. The circle diagram—Fig. 18A—may be drawn either by the method of Fig. 16 or by drawing the circle with centre C of radius C B, and may be oriented in such a way that the vector, *e.g.*, B P, relating to any axis is parallel to that axis, giving the corresponding moment of inertia as O M. The neutral axis N N for a plane of bending perpendicular to the same axis is parallel to R B, drawn as shown, and the stress at any point Z whose distance from the neutral axis, measured parallel to the plane of bending, is z is given by—

$$p = M_c \left(\frac{\cos^2 \alpha}{I_x} + \frac{\sin^2 \alpha}{I_y} \right) = M_c \frac{O\,N}{O\,A \,.\, O\,B}$$

for which the various lengths are easily scaled from the figure.

Earth Pressure.

A graphical construction which is virtually the same as that under discussion has been employed in connection with the theory of earth pressures. If O P_1 and O P_2—Fig. 19—are the principal—compressive—stresses at any point, then no point on the circle on P_1P_2 as diameter must lie at an angle greater than φ, the angle of repose, from the base O P_2P_1. Hence, the ratio of the principal stresses $\frac{O\,P_2}{O\,P_1}$ must not be less than $\frac{1 - \sin \varphi}{1 + \sin \varphi}$, and the limiting—minimum—value of the minor principal stress is $p \cdot \frac{1 - \sin \varphi}{1 + \sin \varphi}$. The corresponding value of the stress on any plane making an angle θ with the major principal plane is given by O Q. Assuming the same permissible obliquity of pressure on a retaining wall as in the earth itself, and following Rankine's theory, the resultant pressure at any point of a retaining wall making an angle θ with the horizontal, due to earth with a horizontal surface, is O N normal and N Q tangential to the wall.

If the effects of adhesion as well as friction are to be taken into account, the diagram takes the form shown in Fig. 20, where O A = a, the adhesion per unit area. The minimum value p^1 of the minor principal stress is then given by—

$$\frac{p^1 + a \cot \varphi}{p + a \cot \varphi} = \frac{1 - \sin \varphi}{1 + \sin \varphi}$$

or—

$$p^1 = p \cdot \frac{1 - \sin \varphi}{1 + \sin \varphi} - 2a \cdot \frac{\cos \varphi}{1 + \sin \varphi}$$

Hence with a horizontal earth surface, the earth is capable of standing to a depth of $\frac{2a}{w} \cdot \frac{\cos \varphi}{1 + \sin \varphi}$ without revetment.

Assuming that the conditions of adhesion and friction are unaltered at the surface of a retaining wall, the pressure on such a wall inclined at an angle θ with the vertical will be given by O N normal and N Q tangential.

If the earth surface is oblique (α) and adhesion is regarded as inoperative, the diagram becomes as shown in Fig. 21, O P representing the stress on planes parallel to the surface and O Q the stress across—conjugate—vertical planes. The resultant pressure on a wall inclined at an angle θ with the vertical is O W, of which O N is normal and N W tangential.

The diagram may be adapted as before to take account of the effects of adhesion.

Geometry of Strain.

Mohr's diagram may be employed to show graphically the components of strain at any point in an elastic material. If e_1, e_2 are the direct strains in perpendicular directions, then the displacement of any point P at unit distance from O is $e_1 \cos^2 \theta + e_2 \sin^2 \theta$ radially and $(e_1 - e_2) \sin \theta \cos \theta$ tangentially. Hence the Mohr diagram—Fig. 22—can be extended to these displacements, O N, N T being the two components.

In an elastic material the strains e_1 and e_2 will be due to normal stresses p_1, p_2 across the planes corresponding to these strains and will be related by the equations

$$E\,e_1 = p_1 - \frac{p_2}{m} \qquad E\,e_2 = p_2 - \frac{p_1}{m}$$

In the stress diagram Fig. 23 draw through C a line making an angle $\tan^{-1} \frac{1}{m}$ with the base. From O, P_2 draw lines perpendicular to the base to cut this line in X and Y. Strike off O O^1 *towards* C and P_2 E_2 *away* from C equal to O X and P_2 Y respectively. Then

$$O^1\,C = \tfrac{1}{2}\left(p_1 + p_2\right)\left(1 - \frac{1}{m}\right) = E\,(e_1 + e_2)$$

$$E_2\,C = \tfrac{1}{2}\left(p_1 - p_2\right)\left(1 + \frac{1}{m}\right) = E\,(e_1 - e_2)$$

Hence the diagram formed with O^1 as origin and circle with centre C and radius C E_2 is the strain diagram corresponding to the stress system for which p_1 and p_2 are the principal stresses.

From this diagram the strain of fibres in any direction can be read off. It follows at once from inspection that :—

(1) The maximum and minimum direct strains are in the same directions as the principal stresses.

(2) Shear displacements for perpendicular directions are equal in value, and opposite in sense. The total shear strain, being from its definition the change in angle between two perpendicular planes, is therefore twice the tangential displacement—*i.e.*, 2 N T = T T^1 in Fig. 22.

(3) The maximum shear strain occurs at 45 deg. to the principal stresses, *i.e.*, on the same planes as the maximum shear stress.

The strain diagram for other systems of stress can be constructed in a similar way, preserving the convention stated above as to the directions in which O O^1 and P_2 E_2 are measured.

As a matter of interest, the modulus of rigidity, C, can be correlated with Young's modulus and Poisson's ratio very simply from the strain diagram, which for simple shear is a circle—Fig. 24—having the same centre O as the stress circle. Clearly shear strain on planes of simple shear = 2 . O S = 2 . O E_1. Hence if p is the intensity of stress,

$$\frac{p}{C} = 2 \,.\, \frac{p}{E}\left(1 + \frac{1}{m}\right) \text{and } \frac{E}{C} = 2 \,.\, \frac{(m+1)}{m}$$

Thick Cylinders.

The distribution of stresses in thick cylinders and cognate problems can be treated in a simple graphical way by adapting Mohr's diagram. Commencing from the fundamental equations

$$p_r = a + \frac{b}{r^2}$$

$$p_l = a - \frac{b}{r^2}$$

for the radial and hoop stresses at various radii, it follows that the centre C of the circle of stress for all radii is distant a from the origin and the radius of this circle is $\frac{b}{r^2}$. If we plot—Fig. 25—the principal stresses along the base of the diagram, as before, and employ a scale in $\frac{1}{r^2}$ along the perpendicular axis of co-ordinates O R, the stresses O P_2, O P_1 can be found for various radii from straight lines C D, C E equally inclined to the base. Normally it will only be necessary to draw the line C D, to obtain p_r. The stress system at any radius can be found when this line C D has been drawn. The method of fixing this line depends upon the data. If, for example, the inner pressure and radius p_1, r_1 are given, then one point, *i.e.* D_1, is determined. If in addition the outer radius and pressure (often zero) are given another point D_2 is fixed, the line D C can be drawn and the diagram completed. From this the maximum stress (R E), stress difference (D E), &c., for any radius can be read off at once.

When one tube or cylinder is shrunk on to another the line D C becomes broken at the common radius, and the location of the two parts of the line depends on the conditions of shrinking as well as the applied pressures. As an example, take the problem† of a gun tube composed of four tubes of inner radii 8in., 12in., 16in., 20in. to be designed to withstand an internal pressure of 8·25 tons per square inch with a maximum stress difference of 10 tons per square inch.

† *Cf.* Case, "Strength of Materials," p. 445,

Under the conditions produced by the explosion pressure the diagram—Fig. 27—is drawn as follows :—D_1 corresponds to 8·25 tons per square inch radial pressure at a radius of 8in. In order that the stress shall not exceed 10 tons per square inch the radius of the stress circle for this radius will correspond to 5 tons per square inch, which fixes C_1. D_1 C_1 meets the 12in. radius line in D_2. To give a stress difference of 10 tons per square inch at this, the inner radius of the second tube, the distance p_2 C_2 again represents

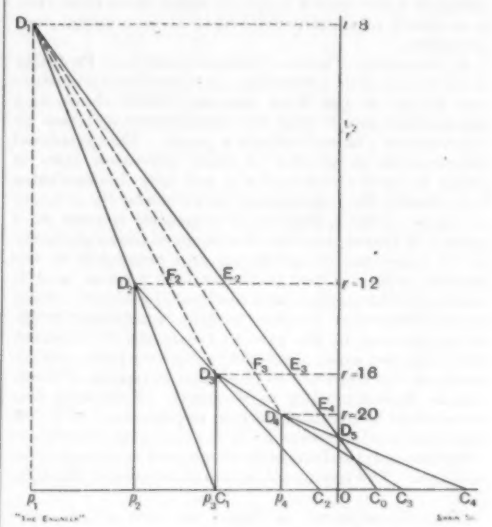


FIG. 27

5 tons per square inch to scale. So for radii of 16in. and 20in. the points D_3, C_3, D_4, C_4 are found in turn. If there is no external pressure the outer radius must be that given by the point D_5, *i.e.*, 24in., and the broken line is a graph of the radial pressures at various radii.

The pressures due to the explosion alone are given by the straight line D_1 D_5, and the necessary initial pressures due to shrinking at the radii of contact are given by D_2 E_2, D_3 E_3, D_4 E_4, which scale off as 2·42, 2·02, 1·07 tons per square inch respectively. The actual pressures with which each individual ring must be shrunk on are given by D_2 F_2, D_3 F_3, and D_4 E_4, and the necessary clearances are easily computed as follows :—

The circumferential strain at the outer radius of one tube

$$= \frac{1}{E}\left(p_l + \frac{1}{m}\,p_r\right)$$

The circumferential strain at the inner radius of the next tube

$$= \frac{1}{E}\left(p^1_l + \frac{1}{m}\,p^1_r\right)$$

and since $p_r = p^1_r$ the difference in diameter to be allowed is given by

$$\delta = \frac{D}{E}\left(p_l - p^1_l\right) = \frac{2\,D}{E} \,.\, C\,C^1$$

where C and C^1 are the centres of the stress circles for the two tubes.

In the case of a solid shaft the radial pressure line D C—Fig. 26—is necessarily vertical and the stress circle degenerates to the point C, but the diagram can be used in the same way as before. To find for example the allowance for shrinking a 12in. O.D. tube on to an 8in. shaft with a pressure of 2 tons per square inch the point D is fixed, and C D dropped on to the base. The point D^1 corresponds to zero pressure at a radius of 6in. and D D^1 produced gives C^1 the centre of the stress circle for the tube. As above

$$\delta = \frac{2\,D}{E} \,.\, C\,C^1 = \cdot 0042\text{in.}$$

B.E.S.A. SPECIFICATIONS.

NAVAL BRASS BARS AND SECTIONS.

The British Engineering Standards Association has issued two specifications for Naval Brass Bars and Sections, No. 251, 1927 (Admiralty Mixture), and No. 252, 1927 (Special Mixture). The first named covers the composition most commonly employed, but there is a growing demand for the alloy given in the second, and it has been thought desirable to incorporate it as a British Standard. Apart from this the specifications are identical. They cover the ordinary sizes of round, square and hexagon bars (for which margins of manufacture are tabulated), and also the more complicated forms of sections largely used in the manufacture of parts for electrical apparatus. In the table of hexagon bars the corresponding BSW, BSF and BA sizes of bright hexagon nuts and bolt-heads are given, so that suitable bars for producing these can be at once selected. Tensile, bend and forging tests are specified.

Copies of these specifications Nos. 251, 1927, and 252, 1927, may be obtained from the B.E.S.A., Publications Department, 28, Victoria-street, London, S.W., price 2s. 2d. each post free.

Railway Matters.

IT is officially announced that since the 9.50 a.m. East Coast relief train from King's Cross commenced, on July 11th, to run non-stop to Newcastle on four days a week, it has made twenty trips without losing a minute.

THE non-stop run of the 10 a.m. from Euston between that terminus and Carnforth is to be continued in the winter train services, which will come into force on September 26th. An additional train of importance will be a 12.30 midnight from Euston to Glasgow, St. Enoch's, which will have sleeping cars for Glasgow, as a relief to the 11.45 p.m.

THE leading axle of the tender of the down day Irish mail broke soon after it had passed over the Conway suspension bridge on Wednesday of last week. The station staff at Conway saw that something was amiss, and the signalman sent the stop-and-examine-train block signal to Penmaenmawr box, and the signals there were put to "danger" to stop the train. The driver had, however, noticed sparks flying when running through Penmaenbach Tunnel, and got his train in hand to stop at Penmaenmawr. The broken axle did not lead to any derailment, so little damage resulted.

THE recent periods of storm and abnormal rain have done considerable damage to the railways in various parts of the country. One such visitation was on the Settle and Carlisle section of the London, Midland and Scottish Railway where, near Culgaith, a slip occurred after the heavy fall of rain on the night of Sunday, the 14th. The line was blocked for twenty-four hours, but through trains were able to travel *vid* Penrith and Ingleton. We make special mention of that incident because in our annual article, "Railways in 1925," in THE ENGINEER of January 8th, 1926, we described the damage done at the same place by a storm in December, 1924.

THE extensive works now being carried out in Piccadilly Circus by the London Electric Railways Company were described in THE ENGINEER of April 29th and May 5th last. These were recently the subject of an inquiry in Parliament, and in reply thereto Colonel Ashley said that, in view of the intricate nature of the works to be carried out, it is not considered that the period will have been unduly prolonged if, as is anticipated, the works are completed by the end of 1928. The Ministry of Transport has been in constant consultation with the railway company relative to temporary hoardings and openings necessitated, and now only one erection on the central island, guarding the main entrance to the works, remains.

ATTENTION has been drawn in the daily Press to the fact that the carriages on the electrically-operated trains on the Southern Railway carry no destination boards. The destination on these trains is given by symbols carried in front of the leading coach, but we must admit that if a passenger fails to see the sign he has no means of knowing whither the train is going except by any announcement the platform staff may make. On the other hand, from the railway point of view, destination boards are a nuisance; they take time to reverse at the end of each journey and longer still to replace by other boards if a fresh destination is intended. We would like to suggest that illuminated train destination boards, as on the platforms of the Mrtropolitan District Railway, would be useful.

THE mishap on August 10th to the Cornish Riviera Express on the Great Western Railway, mentioned on page 195 of our issue of August 19th, has led to a letter to *The Times* from the Medical Officer of Health of the City of Bristol, which indirectly suggests that the accident should be inquired into. We would therefore say that under the Regulation of Railways Acts, 1871, such an accident as, being a case of "any passenger train or any part of a passenger train accidentally leaving the rails," must be reported to the Ministry of Transport. It would there come under the personal notice of the chief inspecting officer of railways, who would take one of two steps, should he not be satisfied with the company's explanation for the accident. He would either order an inquiry forthwith or would ask the company for further facts. In the second event, were the answers not to his satisfaction, an inquiry might follow.

RAILWAY interests will be grateful to the *Manchester Guardian* for the leading article in its issue of Saturday last, wherein there was supported the proposal made recently by Mr. William Graham that there should be an inquiry into the question of giving powers to the railways to run road services. It is pointed out that under the Railways Act, 1921, the companies are entitled to rates that will yield them a standard revenue equivalent to their pre-war revenue. That, says our contemporary, "was not too generous to the railway shareholders, since it made no allowance for the fall in the value of money and the rise in the general level of interest yields since 1913; yet, such as it is, the railway companies have not yet benefited by it. They have been unable to earn this standard revenue." It is a strange coincidence that *The Times* of Monday last devoted its first leading article to the same subject and with the same recommendation.

THERE are very gratifying signs of co-operation between the railway companies and their men. That partly has been brought about by the men recognising that road competition is doing the companies harm, and one of the resolutions unanimously carried at the recent annual general meeting of the National Union of Railwaymen was to the effect that the companies should be given powers to run road services. A letter from one of that union's officials which appeared in the men's organ, the *Railway Review*, of the 12th inst., under the heading "Co-operation or Chaos," said: "The brightest aspect of the dark situation is the excellent spirit of comradeship existing betwixt officers of the company and the N.U.R. locally—and probably in other districts. As one who has never hitherto failed to appreciate their broad human outlook, I continually find fresh evidence thereof. Other union officials now express a desire to join in, and if anything I can say or do will tend to lay deeper and broader the foundations of the new peace edifice I shall be more than repaid. The right hand of fellowship being offered, it would be both churlish and childish to reject the same."

Notes and Memoranda.

A HUGE boulder, a short distance from a well or spring near Cuba, N.Y., U.S.A., marks the spot, we are told, where a Franciscan missionary, Father Joseph de la Roche d'Allion, three centuries ago discovered in the then wilderness the source of an oil called by the Seneca Indians "atouronton."

THE Secretary for Mines announces that he has appointed a small Committee, consisting of Sir Frank Heath, G.B.E., K.C.B. (chairman), Mr. C. G. Douglas, M.D., F.R.S., and Mr. George Gibb, consulting mining engineer, to inquire and report whether the use of the harness known as the "guss" for hauling wheelless tubs in the Somerset coalfield is harmful from the point of view either of health or of safety, and, if so, what practicable methods of working could be employed to obviate its use.

ACCORDING to the annual report for 1926 of the Chief Secretary to the Government, Federated Malay States, interest in oil palm cultivation has been well maintained during the year, the area set aside for this cultivation being over 30,000 acres, of which 10,000 acres are actually planted. Three estates have reached the bearing stage, two being equipped with modern machinery for the preparation of a high-class oil. The yields for 1926 were 751 tons of palm oil and 168 tons of kernels. Further areas of over 100,000 acres in extent, chiefly in Pahang, are provisionally reserved for this cultivation. The Department of Agriculture is experimenting at Serdang with new varieties of oil palm (the nipah palm) from West Africa.

TWO articles were published in the July issue of *Electrotechnics*, issued by the Electrical Engineering Society of Bangalore, India, on the practical application of electricity to heating and cooling. The first presents a short account of some recently introduced forms of electric furnaces, a subject well worth careful attention in India, especially where electric energy is cheap. The second article is contributed by Mr. J. H. C. Kann, Assistant Professor of Mechanical Engineering in the department of Electrical Technology, at the Indian Institute of Science, Bangalore, and deals with the latest types of electrically operated refrigerator particularly from an Indian standpoint. Mr. Kann gives some data of the power consumption of a small machine now running in the Indian Institute of Science.

ACCORDING to Mr. J. P. Burnside, the Chief Inspector of Factories and Steam Boilers in South Australia, the equipment necessary for burning South Australian brown coal should comply with the following conditions:—The furnace should have sufficient volume and sufficient brick walling for storing heat to radiate back to the incoming raw coal, so that the kindling temperature may be obtained without reducing the combustion temperature unduly; the fire-grate must be of sufficient area to provide for at least a normal rate of evaporation of the boiler when consuming a reasonable weight of coal per square foot of fire-grate per hour, say, 40 lb. to 50 lb.; the maximum amount of work in connection with the generation of steam from low grade fuel must be done mechanically, and with the minimum amount of handling and hand labour.

IN concluding a lecture before the Midland Branch of the National Association of Colliery Managers, on the relative merits of steel and wood as a material for pit props, Mr. G. H. Riley pointed out that it was not possible to reduce roof support at the face to exact engineering figures as for load supports generally, but the practical side of the question was that between timber usually used and the size of steel prop that would supersede it there was a margin of approximately 4in. of yield and 15 tons carrying capacity (about 100 per cent. in each case). Thus there was, in cases of heavy roof and large subsidence that were much beyond the capacity of timber, enough to give the necessary yield and safely carry the load and still leave a margin within the capacity of the steel prop. The steel prop was an advance of 100 per cent. on the timber prop, and this superiority had a marked effect in reducing accidents.

DURING some shunting operations at Upington Station in the early part of July, one of the special "explosive" trucks, containing a few cases of dynamite, was, according to the *S.A. Mining and Engineering Journal*, driven with such force against a heavily-laden coal truck that it was overturned and its contents scattered over the rails. One or two of the cases of dynamite were burst open, and the explosive lay loose all over the ground. An engine and tender travelling on the adjacent track ran right over and through the stuff, and it is stated that the rails were actually smeared over with dynamite for some yards. And no accident happened, no explosion resulted from this drastic treatment! If a small portion had detonated the chances are that the whole lot would have exploded and Upington Station would have been wrecked. While not reflecting any credit on the methods of the railway staff, the incident shows how "safe" modern explosives are, and what care is taken in their manufacture in this country. It was no doubt very lucky that the weather was cold; with a temperature approaching 100 deg. in the shade the results might have been disastrous.

THE ultra-violet ray treatment is, according to the *Iron and Coal Trades Review*, to be applied to men working in the coal mines in Nottinghamshire in the event of experiments proving satisfactory. A party of pit lads recently left the Sherwood Colliery for two weeks in the Swiss Alps. The trip is a prelude to a pit-head test of the industrial value of the violet ray, which is to be made in the early autumn by the New Health Society, in co-operation with the National Institute of Industrial Psychology and Sunlight League. Mr. C. H. Heathcote, the agent and managing director of the Sherwood Colliery Company, Ltd., in an interview said, that preparations are already in hand for the experiment in the autumn. A building equipped with the latest ultra-violet ray apparatus is to be erected at the pit-head, and employees at the colliery will undergo thorough tests which will enable experts to determine the effect of ultra-violet ray treatment on their health. The tests will be carried out under proper supervision, and a consulting doctor will probably be in charge. If the tests prove successful, it may lead to some general scheme of ultra-violet ray treatment for pit boys and young miners. He added that it was to induce the boys at the colliery to take an interest in the experiment that the New Health Society had arranged the trip to Switzerland.

Miscellanea.

A COMPANY, with headquarters in Paris, has been formed for the manufacture locally of industrial alcohol.

IN the course of some road repairing operations in the town of Port Arthur, Ontario, some veins of silver ore have been discovered.

THE first portion of the works for the improvement of the Port of the Piræus, carried out by a French company, was opened on August 22nd.

IT is expected that the output of asbestos from the Cyprus mines will be of the order of 12,000 tons a week before the end of this season.

IT is proposed to expend three-quarters of a million dollars on the sand filtration system of the Montreal water supply, and so to increase its capacity to 100 million gallons a day.

THE scheme for the improvement of the harbour at Montreal, which will involve an expenditure of 12,000,000 dollars, will increase the grain storage capacity of the port from 12,162,000 bushels to 15,162,000 bushels.

IN view of the value of the work which it has so far accomplished and the inadequacy of the financial resources of the British Engineering Standards Association, the Institution of Electrical Engineers has this year made a grant of £1000 to its funds.

THE Mauretania, arriving at Plymouth early on the 23rd inst., accomplished her fastest voyage of the year. She made the passage from New York to Plymouth in 5 days, 2 hours, 24 minutes, at an average speed of 25·29 knots, with the best day's run over 600 miles.

THE entrance to the Hunter River, which constitutes the harbour of Newcastle, New South Wales, situated about 80 miles north of Sydney, is being deepened by the removal of about 15,000 cubic yards of stone annually. The total quantity of stone to be excavated from the bar is 280,000 cubic yards.

THE farm owned by the Prince of Wales at Lenton, Nottingham, will, according to the *Ironmonger*, be supplied with electricity from the power station at Wilford. It will contain no fewer than 110 points. There will be an electric pump to fill tanks with water which will be mechanically conveyed to drinking troughs. An animal in the act of drinking will, by pressing its muzzle on a flange, release the water, which will be automatically shut off when it has finished.

SALES of natural graphite by American producers in 1926 were 5145 short tons, 10 per cent. increase compared with 1925. The increase was in the crystalline variety, amorphous graphite decreasing in both quantity and value. The manufacture of artificial graphite in New York increased considerably, from 12,135,655 lb. in 1925 to 21,163,986 lb. in 1926, or 74 per cent. The imports of graphite in 1926 amounted to 16,166 short tons, compared with 17,768 tons in 1925, a decrease of 9 per cent. in quantity and an increase of 11 per cent. in value.

IT is expected that the new rubber factory at Delmore, South Africa, will be in commission before the end of this year. It will provide employment for some 300 hands, and the principal products will be hose, railway hose, general classes of hose for specific work, rubber heels, sports soles and soleing, light truck tires, moulded goods of all descriptions and rubber flooring. Preparations are under way for the production of tennis balls, conveyor belting, transmission belting and inner tubes. The future production programme includes motor car tires and tennis shoes and rubber footwear.

IT is reported from San Diego, California, that plans have been completed and specifications prepared by the Ford Motor Company for a 100-passenger aerial Pullman which will make its first flight this autumn. This announcement was made recently by Mr. W. B. Mayo, chief engineer of the Ford Motor Company, who said that he had devoted over two years to the designing of a 100-passenger all-metal monoplane with air-cooled radial engines. The machine, he added, would be fitted with sleeping quarters and all the facilities and comforts of the finest railway coach. It would have six engines, a speed of 125 miles an hour, and a cruising radius of about 700 miles.

A REPORT from Madrid states that Senor Jose Yanguas, the former Foreign Minister and head of the Spanish delegation in the negotiations with Portugal, has just concluded with the Portuguese representatives a convention for the utilisation of the water power of that part of the river Douro which forms the boundary between Spain and Portugal. The report adds that a proposal to call an economic conference between Spain and Portugal in October is being considered. The aim of the Conference would be to conclude a commercial treaty dealing with telephonic and wireless communications between the two countries and also with shipping, industry and fisheries. The Conference would also discuss the question of constructing a railway line extension which would considerably shorten the journey between Lisbon and Madrid.

A NOTE in the *Engineering News-Record* gives the following news as to the aftermath of the floods in the Mississippi Valley, which occurred this spring. Rivers within the New Orleans district are all within the bankful stage, according to the August 1st special flood bulletin of the New Orleans office of the Weather Bureau, but the drainage of flood water from low-lying land areas is slow and it is estimated that from 30,000 to 35,000 acres of agricultural land are still under water in Louisiana. Considerable areas of swampy bottoms with a small percentage of farm land are still under water in the Tensas Basin, the principal portion of this overflow lying in Tensas, Concordia and Catahoula parishes. Below Red River a large area in the central and lower Atchafalaya Basin in the vicinity of the main stream and the lakes is still inundated with considerable agricultural land under water or too wet for cultivation, mostly in St. Martin, Iberia, St. Mary and Terrebonne parishes. West of Bayou Teche and also in the Tensas and Atchafalaya Basins, there are flooded depressions with some agricultural land included from which relief from flood waters will be slow, mostly by percolation and evaporation.

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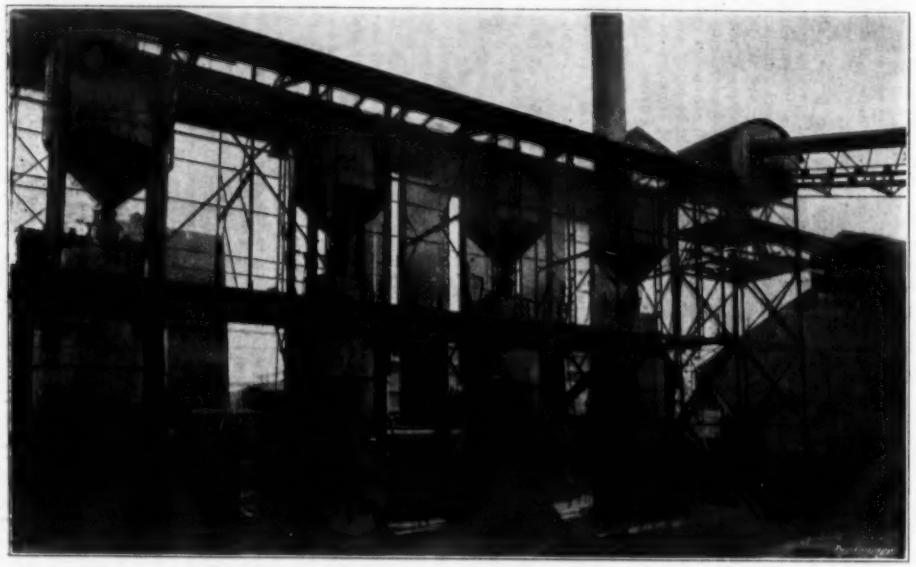

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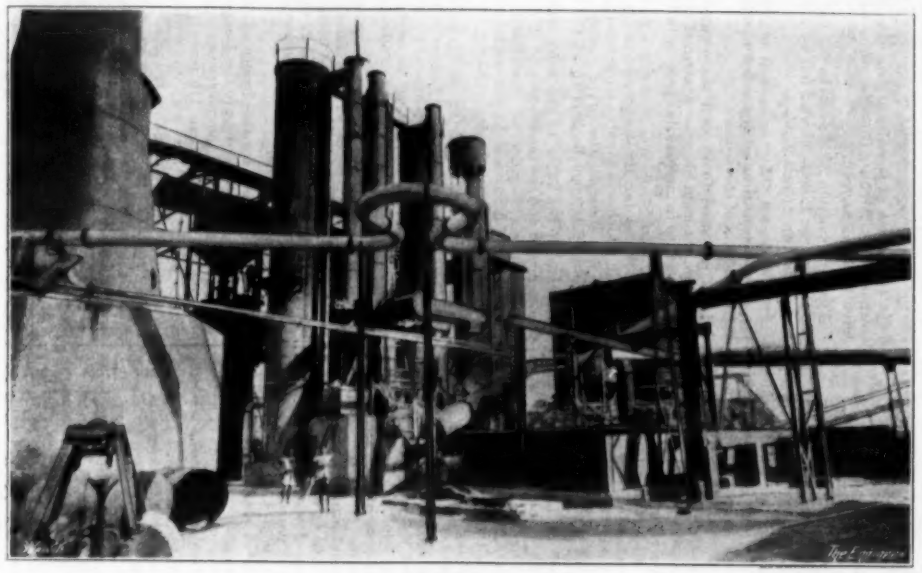

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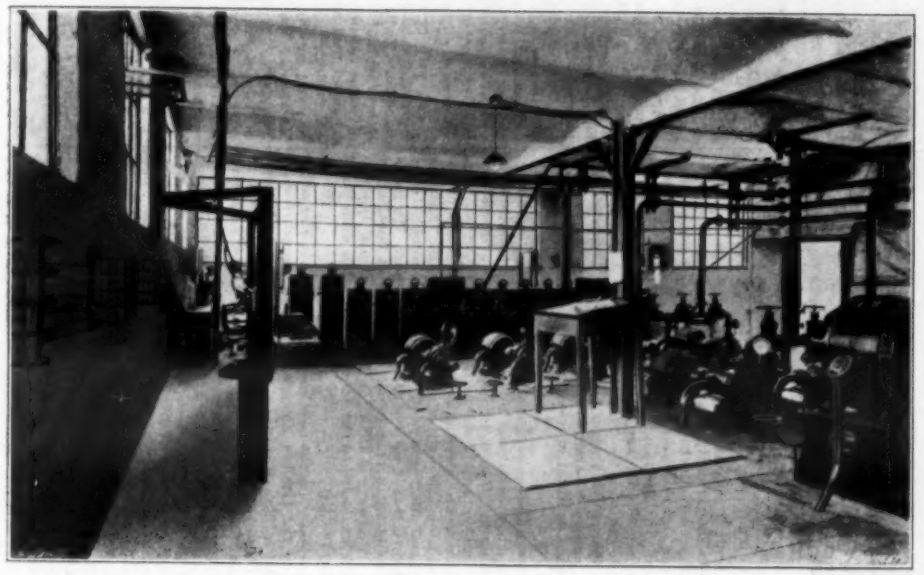

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THE ENGINEER.

AUGUST 26, 1927.

Inland Navigation Abroad.

THERE are many people who believe that in a country with a highly developed railway system and abundant supplies of coal the canal is obsolete as a means of transport. It is too slow in these days of hustle; it is inefficient; it is uneconomic; and, in short, it ceased to be tolerable after the invention of the locomotive. Does not the state of our own canals—narrow ditches with a few barges of coal or cotton on them in the industrial districts, or sleepy weed-grown lanes of water in the country, when they are not dried up altogether—justify the obsolescence of canal transport without further argument? Who, indeed, would build a new canal to-day in the face of railway competition? If nobody could be found to risk money in the improvement of existing, not to speak of the construction of new canals, the case against them might be considered proved without further argument. But one has only to travel a very little way out of England to find canals playing an essential part in the economic life of continental countries and important works for their improvement and extension continually put in hand as a matter of course. The waterways of Europe, canals and canalised rivers, are comparable in importance with the railway systems, so far as freight traffic is concerned. They are no more a substitute for railways than roads are, but railways, waterways and roads each take their share in the scheme of things, with natural rivalry, but with room for all. Far from being moribund, water transport is in an active stage of development, and it is probably true that at the present time the work in hand and the schemes projected for improving inland navigation outclass the corresponding developments of railways. The Exhibition of Internal Navigation and Hydraulic Power—the order of the two subjects is significant—which was held last year at Basle, must have opened the eyes of many visitors. The occasion of the exhibition was the inauguration of the port of Basle, with two thousand feet of wharfage and ample crane equipment for cargoes going to and from the North Sea, 500 miles or so away. Switzerland is also hoping soon to be in direct water communication with Lyons and so with Marseilles by a new canal from the Lake of Geneva, and with the Danube by a canal from Lake Constance to Regensburg capable of carrying 1200-ton boats. A glance at the models of some of the locks and boat elevators employed on some of the continental waterways was sufficient to show what costly works the advantages of canal transport are held to warrant.

The continental conception of canals is so different from that prevailing in this country, that it is difficult to find any basis of comparison. We have the Manchester Ship Canal, it is true, but what of any other artificial waterway. In his recent lecture on "English Railways," before the Royal Society of Arts, Professor Dalby, wishing to draw a parallel between railway and canal transportation in England, considered the carriage of 1000 tons of coal. "To move this weight of coal . . . in canal boats," he said, "would require twenty barges, not to mention the time lost at the locks." No doubt it would in England, but a European critic might retort: "If your canals were as ours are, you could take the load in a single boat or a fraction of a boat on a good waterway, instead of requiring about a hundred little trucks to haul it, and you would handle it far more cheaply." Nor has this canal development on the continent taken place at the expense of railway development. In Belgium, for example, in proportion to its area, there are more than twice as many miles of railway as in Great Britain. This does not look as if railway construction had suffered much, yet it has to compete with canals capable of carrying 3000-ton loads from Ghent to Terneuzen, 2000-ton loads from Brussels to Antwerp, and loads of 300 to 600 tons between all the important centres of the country. The faith of the Belgians in the future of canals is shown by the recent unanimous recommendation of a Special Commission that a quite new canal capable of carrying boats of 1350 tons capacity should be constructed from Liége to Antwerp, and that land should be acquired with a view to the eventual accommodation of 2000-ton boats. This decision, which will no doubt be carried out, must be considered in the light of the fact that there is at present canal accommodation for 450-ton loads between the same cities, and that the water for the new canal will have to be obtained by the construction of reservoirs in the Ardennes. In Holland there is also activity in the construction of new canals. The Juliana Canal, begun in 1925, is designed for boats of 2000 tons, with locks 440ft. long, and bridges having 23ft. of daylight. The Dutch programme, which will not be completed before 1932, also includes the canalisation of the Meuse for 110 kiloms., from the end of the Juliana Canal to Grave with locks capable of taking a 2000-ton boat and its tug. A canal from the Meuse to the Waal, 13 kiloms. long and also with locks for 2000-ton boats, will be finished this year. There is also a canal, 17 kiloms. long, now being made from Wessem to Neederweert to link up the industrial region of Brabant to the Dutch coalfields by way of the Meuse and the Juliana Canal. It will be constructed for 600-ton boats at first, but an ultimate enlargement to accommodate 2000-ton boats is envisaged. That these and other canal developments on the Continent are assisted by the existence of important natural waterways, such as the Rhine, Rhone, Meuse, Elbe, Weser, Danube, &c., is incontestable. But it must never be forgotten how much art has had to assist nature to render many of them useful for navigation far inland. The true canals, moreover, owe nothing to nature. They are purely artificial waterways carried often through difficult country with the single object of providing transportation facilities for merchandise more cheaply than it could be provided by rail. That waterways are appreciated by manufacturers and merchants is shown by the location of industries along their banks. Even more convincing perhaps is the tale of traffic. During the year 1924, of the 97 million tons of merchandise carried by rail or water in Belgium, 27·5 million tons were consigned by water. Freight rates on the waterways occupy every week half a page of *l'Usine Belge*. They are lower than the railway freights for long distances, such as are traversed by international traffic, but for moderate hauls, such as between Antwerp and Liége, special railway tariffs make the

difference very slight. Statistics, however, show that water-borne traffic is made up for the most part of comparatively short hauls, averaging less than 40 miles, which seems to prove that the canal services are often commercially advantageous, even for short distances.

Enough has been said to show how widely divergent are the views of English and continental engineers on the subject of inland waterways. It is not our object now to judge between them. Nor is it worth while to discuss at length the reasons responsible for the decline of the English canal system. The charge, often made, that the railways acquired them and strangled them is not really a fair one. The railway boom in the 'forties of the last century was accompanied by something in the nature of a panic amongst canal shareholders, and certain railway companies could only obtain their parliamentary charter on condition that they acquired canals, the existence of which was thought to be threatened. It could hardly be expected that the canals would be energetically developed by their railway step-fathers, the primary interests of which were opposed to them. This change in ownership, combined with the public fear of the future of canals, is no doubt largely the reason why in this country 50-ton canal boats are taken as typical, while anything less than ten times that capacity is considered obsolete on the other side of the North Sea. It is beside the question to say that the continental canals are Government undertakings and have been developed in defiance of economics. The railways with which they compete are equally Government undertakings, and there is no reason to believe that the policy which has developed one is not as sound as that which has been responsible for the development of the other. Indeed, the strategic value of railways being so immeasurably superior to that of canals, if any bias on the part of the Government were to be suspected, it would be in favour of the railways. With this in mind, it is unreasonable to suppose that Government after Government would spend money in the continual extension of old and the construction of new waterways, merely for the pleasure of competing with itself. The canals have been developed for the same reason as the railways, namely, that the people interested in the industrial life of their countries wanted them. They give a service which the railways cannot give, and their presence encourages industries. At any rate, this seems to be the continental view, and the fact, mentioned above, that nearly one-third of the freight traffic of Belgium is waterborne in spite of a density of railways unequalled elsewhere in the world, would seem to show that the view is at least a tenable one. In comparison with the Continent, we have, of course, no rivers like the Rhine or the Meuse, to invite great works of canalisation or to suggest canal construction generally, but one wonders whether, had the Trent or the Severn, for example, been on the Continent, some greater possibilities of their service to the inland industrial centres would not have been discovered.

The Railway Position.

It will be a year on September 3rd since we last considered the question of the immediate future of British railways. Our silence since then has not been due either to indifference to that important subject or to any feeling of satisfaction that there was nothing to be concerned over. The British railway position is, in fact, very bad, but, in our opinion, far from hopeless. With the former of these two observations there will be no quarrel, but our optimism may be challenged, and we must therefore indicate our grounds for hope. We found them mainly in two conditions :—(1) The happier relations between the companies and the traders, and (2) the desire of railwaymen to co-operate with the administration for the retention of existing business and the acquisition of new. Proof of the happier relations with traders is soon given. It is to be found in what passed at the Railway Rates Tribunal on July 6th, when January 1st next was fixed as the "appointed day" on which the new scale of charges, that has been under review for a goodly proportion of the last three years, comes into operation. On that occasion, counsel for the railway companies paid a compliment to the constructive criticism by traders and thanked them cordially for their friendly attitude, whilst the President said that one of the greatest causes of satisfaction was the atmosphere of goodwill prevailing throughout the proceedings. Such a tribute would not have been possible thirty years ago. In fact, the opposite prevailed as recently as 1912 when the Government of that day, in redemption of its promise to the companies made at the time of railway strike of August, 1911, brought in legislation to allow the railways to raise their charges sufficiently to meet the increased expense arising out of the sequel to the settlement of that dispute. There was strong opposition to the proposals, more particularly from the Government's own supporters, and it was only by the firm attitude of Mr. Asquith, the then Prime Minister, that, two years after the promise, the Bill was carried. What, furthermore, will make the future relations between the parties happier is that the fixing of charges now lies with the Tribunal. That body is a Court of two members, besides the President, one of whom is more or less a representative of the trades, whilst the other is a former railway officer.

A very interesting and instructive story could be told of the origin of the proceedings we have been referring to. But it is too long to touch more than the fringe of it. Like many other reforms and changed methods, it arose out of the war. All remember how, at the outbreak of hostilities, the railways passed under the control of the State, and were thereafter administered by a committee of railway general managers, under the nominal chairmanship of the President of the Board of Trade. The railways were at once relieved of financial anxiety by the Government guaranteeing the net receipts as in 1913—a good bargain, as that was the railways' record year. The cost of living, it will be remembered, rose and was met, at the Government's instructions, by a war bonus, which at frequent intervals was increased. In November, 1917, the men were given an extra 6s., making the bonus 21s. The Railway Executive Committee tried to call a halt, but without avail, and thereupon issued a statement that it was, in making further advances, acting under the orders of the Government. In a sense, there was no occasion for any such apology as the railways, despite the fact that rates and charges remained unaltered, although costs were increasing at an alarming rate, were more than making good, not only in their excellent work and maintenance of physical condition, but in their cost of operation. As a matter of fact, we had occasion to remark, on the last point, in The Engineer of September 22nd, 1916 : "The advantages are now, however, so very one-sided, inasmuch as on the transaction the country is making a profit at the expense of the shareholders, that it is reasonable to ask that the situation be reviewed, and as the present conditions (as to the guarantee of the net receipts of 1913) have been in force for two years, a change be made and the companies be allowed to run the railways as their own." Nothing of the kind was, however, done. The Government was concerned only in winning the war and the companies were too magnanimous to interfere at such a time ; both recognised that increased expenditure on the railways was just then a minor affair. What, in a sense, made matters worse was that the railway business was being so well done that the companies were left severely alone. Thus, their very success proved their undoing. And so the cost went sailing gloriously upwards and, by November, 1917, when the Executive Committee entered its protest, the war bonus was not only 21s. per week, but it was no longer treated as such, being made part of the men's regular wages and so included in the calculations for overtime, night duty and Sunday duty. Not only did the Government make that concession, but in December, 1918, regardless of the cost, of the inopportunity of the moment, and of the inconvenience, it gave all railwaymen, whether their duties were strenuous or light, an eight hours' day. So inconsiderate was that step that Sir Herbert Walker, speaking at the London Rotary Club in June, 1921, referred to the concession as perhaps the most wicked thing that had ever been perpetrated on a community. When hostilities were over and improved transport was made a plank in the Government's political programme, the railways were costing one hundred millions a year more than in 1913. Sir Eric Geddes, not properly weighing his words, kept calling that "a deficit," but it was nothing of the kind. Actually, the year 1918 showed a deficit of thirty-five millions, but the accounts excluded all traffic for the Government, as it was carried free ; even in 1919 the loss was only forty-one and a-quarter millions. It must be remembered that through all those years traders were having their traffic—mostly of the greatest value—carried at 1913 rates. Had, therefore, the railways, from about 1916, been run, as was suggested in The Engineer, on a commercial basis, there would have been no loss. That, as we have said, was not done, and from 1919 onwards the railways fell on evil days. Not only was trade bad and there was a coal stoppage of three months, but, to cap everything, an award of the National Wages Board in June, 1920, gave the same wages to men in certain grades, regardless of the amount of work they did. Out of those troubles, however, good has come, for all must now admit that the setting up of the Rates Tribunal and the confirmation of the Wages Boards and establishment of local councils, have done good.

The desire of the railwaymen to further in every way the interests of their employers is a distinctly bright feature in the present railway position. At the recent annual general meeting of the National Union of Railwaymen resolutions were passed almost unanimously which (1) condemned pilfering ; (2) considered that the drivers of motor vehicles should have their hours of duty controlled as were those of railwaymen ; and (3) favoured legislation which would enable railways to provide road services. Since then meetings between local officers and men have been held at various centres for the deliberate purpose of effecting co-operation for securing new and retaining existing business. The possibilities of the companies obtaining road powers—quite likely by the action of the Government itself—are now decidedly bright, and there is also a prospect of co-operation between the railway companies and the providers of road transport. All that is to the good. The railway position is made still more hopeful by the wonderful resources of the companies. The remarkable manner in which they adapt themselves in times of emergency, as also their ability to rise to any occasion and to adjust conditions to needs, show that there are at present no grounds for being uneasy as to the ultimate recovery of British railways.

The Report of the Heat Engine Trials Committee.

The hope that, at long last, we have the basis for accurate and easily comparable tests of boilers and engines of all kinds gives to the recently issued report of the Heat Engine Trials Committee a special interest. It has been produced under favourable auspices. The Committee responsible for it was appointed in 1922 under the chairmanship of the late Captain Sankey, at whose death three years later the duties of chairman were accepted by Mr. W. H. Patchell. Composed of over sixty members, including representatives of fifteen engineering bodies and three Government Departments, and carrying out its deliberations by means of numerous sub-committees and panels composed of members with special qualifications, it might be expected to speak with experience and authority, even over the wide field which its work has covered. What it has done is not, primarily, to tell us how plants of various kinds ought to be tested, but to draw up a series of codes for tabulating the results of trials. These codes cover boiler plants with the usual accessories, steam engines, turbines for land or marine use, condensing plants, gas producers, gas engines, petrol and paraffin engines, heavy oil engines, and compressors and blowers. The fullness with which the work has been carried out is shown by the fact that the boiler test code, for example, contains provision for no less than 211 separate entries. We hasten to add that not all of these are expected to be filled in in respect of a test on any particular plant. Large numbers of them are alternative, to be used or not according as the boiler is fired by stoker, pulverised fuel, oil or gas. Of those which apply to a given plant, a further large number is marked with an asterisk, indicating that they are only considered necessary when the test is carried out for ordinary industrial purposes. As a matter of fact, the items to be filled in, in the case of an ordinary stoker-fired boiler with economiser and superheater, but without air heater or steam reheater, amount to 113 if the test is to be considered a scientific one, or to 46 only for an industrial or "acceptance" test. Regarding the codes generally there is little room for criticism. The quantity of data to be recorded may appear to some people excessive, but for a really scientific test they are all necessary, and the limited number which apply to an ordinary test cover nothing but those facts which are essential if the merits of the performance are to be properly demonstrated. The fault of complexity, if there is one, lies not in the codes but in the subject.

Although, as has been mentioned, the main object of the Committee was to standardise the presentation of test results, and not to lay down a series of rules for testing, the codes would have been practically useless without some directions as to how the various data ought to be obtained. Hence, each code is supplemented by several pages of brief explanatory notes, conveniently numbered to correspond with those items which need elucidation. The way in which these notes are worded indicates a realisation of the controversial nature of many subjects, such as,

for example, the reliability of various methods of measurement, and the Committee is to be congratulated on the wisdom displayed in avoiding trouble. Metering questions in general are met by the requirement of a statement as to the method adopted, though when alternative methods are possible a hint is usually given as to the method which the Committee considers best. Other means may be used, at the risk of the person making the test, but he must in any case say how he made his measurements. This attitude of liberality has much to commend it. As regards the determination of fuel quantities, for example, it is recommended that fuel oil should be weighed, though the use of calibrated measuring tanks is mentioned as an alternative. The quantity of waste heat gases may be determined either by measuring the rate of flow or may be calculated from chemical considerations. In the case of powdered fuel the Committee makes no suggestions—a course which is safe, though regrettable. Feed water, the next important item, should be either weighed or measured in calibrated tanks, though indicating water meters are permissible when the tank methods are impracticable. The use of steam flow meters to determine the quantity of water evaporated is neither sanctioned nor forbidden. The possibility of their use for this purpose is simply ignored, though they are recommended for the equally difficult work of measuring steam passing to a reheater, and, by inference, are permissible as a means of determining the steam consumption of a turbine. Ordinary CO_2 meters are ruled out by the requirement that, even in industrial tests, both the carbon dioxide and the carbon monoxide in flue gases should be measured. No method of determining the proportions of these two constituents is, however, suggested, and the Committee is silent on the question of using any of the automatic apparatus available for the purpose. The advice that "the usual spot analyses" should be supplemented by the analysis of an average sample, seems to imply a belief that an apparatus of the Orsat type is the only one available. These, however, are minor matters, and the freedom generally allowed by the Committee is far preferable to explicit directions which would have involved the whole business in an atmosphere of contention. The great thing is to have the figures substantially correct, and if that is assured the most convenient way of arriving at them is the best one. The accuracy of a boiler test, moreover, depends on other factors than those we have mentioned. First and foremost is the calorific value of the fuel burnt. As to obtaining a sample, an elaborate method proposed by the Fuel Research Board is quoted as one of the appendices to the report. The sample having been obtained, the determination of its calorific value and analysis "should ordinarily be referred to specialists." This simplifies the test, in so far as the engineer is concerned, but specialists, even with well-known laboratories, are capable of getting such extraordinarily divergent results, especially when unknown to themselves they are repeating tests on the same sample, that it would have been well for the Committee to have called attention to the desirability of employing at least two independent analysts to determine the calorific value of coal on any important trial. In connection with fuel testing there is a crying need for an investigation, by statistical methods, on the "probable error" of a coal test carried out on a random sample, and on the number of such random tests required to give an average result sufficiently close to the "true" value. An investigation of this kind would be of more practical use than most of the so-called "research" now going on in connection with coal, as it would at least show where we are with regard to coal testing, and it would very possibly enable quite as great accuracy as is now obtained to be got without the extraordinary and costly sampling operations now carried out in the hope of finding a thimbleful of coal which is truly representative of a truckload. Another factor which affects the reliability of a boiler test is the time during which the test lasts. The Committee is satisfied that an actual test period of four or five hours, preceded and followed by control periods of one hour each is sufficient, a brick-set boiler being previously under steam for at least twenty-four hours and a steel-cased boiler for at least twelve hours before the first control hour, to ensure the setting being thoroughly warmed up. With full sympathy for everyone engaged on the work, we think the test time is too short. A test of twenty-four hours or even more is common in connection with large boilers in America, and in spite of the inevitable fatigue and changes of observers, that such a test involves and the accompanying possible errors in determining times and measurements, the overall accuracy is likely to be far greater than in a test of a few hours only.

Features to which the report owes much of its interest are the introductory chapters to the set of codes relating to steam and internal combustion engines and the appendices at the end. The first chapter deals with the method of calculating the efficiency of a steam plant working on various cycles. While it is vastly better than the first draft presented for discussion at one of the public meetings held in connection with the work, and is also very much better than when published in its provisional form, it is even yet not beyond criticism. The definition of the Rankine engine as "an ideal engine which would convert the whole of the energy available from the temperature difference established by the boiler and condenser into mechanical work" would seem to be both tautologous and indefinite. The Rankine engine is merely an imaginary engine working on a Rankine cycle, and the latter has never been better defined than by Ewing in words that every engineer knows. In calculations relating to the various cycles it is rightly recommended that Callendar's steam tables should be used, yet throughout the chapter the symbol I is employed to represent total heat, although that quantity is only to be found tabulated as H in the tables referred to. This is one of those irritating little things which so easily might have been avoided. The symbol H is also used in the new Mollier diagram produced by the B.E.A.M.A. Committee, and apart from the authority of Callendar, its suggestion of the word "heat" would indicate its use. A further defect of the chapter in question is the omission of any explanation of how the principal cycle calculations are made from the data given in steam tables alone. It is recommended instead that heat drops, &c., should be read from a Mollier diagram, a method which, though extremely convenient, is much less satisfactory than calculations based on the tabulated properties of steam. In the two previous drafts of this part of the report this fact was recognised and the change to graphical methods is a retrograde step. The appendices to the report are eleven in number. The first tabulates definitions and values of fundamental and derived units and constants. Then follow "Notes" on Pressure Measurement, on Flow Measurement, on Temperature Measurement, on Calorific Values, on Specific Heats of Gases, on Power Measurement, on Electrical Measurements, on Gas Sampling, on Coal Sampling, and on Smoke Intensity Diagrams. Space forbids us to comment on them. We may mention, however, that the note on calorific values merely justifies the decision of the Committee to abandon the lower calorific value, recommended by the old Civil Engineers' Committee, in favour of the higher calorific value, although such justification was really unnecessary.

The report, which is published by William Clowes and Sons, Ltd., at the price of five shillings, even if it does not meet the views either of those who would have liked less, or of those who would have liked more, is one which is an immense advance on anything that existed previously, and justifies the appointment of the Committee which has evolved it.

Literature.

The Activated Sludge Process. By ARTHUR J. MARTIN, M. Inst. C.E., &c. London: Macdonald and Evans. 1927. Price 30s.

A VERY great deal has been written during the last ten or twelve years concerning what is termed the activated sludge process of sewage disposal, but we do not know of any other single volume in which the present-day knowledge of the subject has been more ably brought together than this book of Mr. Martin's. That finality in sewage disposal, either by the activated sludge or any other method, has been reached, no one—least of all Mr. Martin—would dream of asserting, yet there will be many who agree with him that the time is fully ripe to bring together—as he has done—the facts which have up to now been established and the results which have already been achieved in connection with this, the newest system of sewage treatment. To attempt to give within the limits of space at our disposal a detailed account of the full contents of the book—which runs to over 400 pages, is divided into twenty-eight chapters, with seven appendices, and nearly sixty tables and seventy-six illustrations—would be impossible, and a brief reference to some of its leading features must suffice.

The first chapter is devoted to a summary of the early experiments in the aeration of sewage, and reference is made, first of all, to the work of various investigators in this country and abroad, and then, finally, to the discovery of the organism M7 by Fowler and Mumford. In Chapter II. is discussed the early work of Ardern and Lockett, while in Chapter III. the plants which were put to work at Withington and Davyhulme are described and illustrated and their working reviewed. In Chapter IV. more or less lengthy references are made to other British works using diffused air, including those at Salford, Worcester, Stamford, Tunstall, Hanley, Reading, Coventry, and Glasgow. Up to this point the author has dealt solely with experiments and plant in which aeration and agitation are effected by means of compressed air; but he turns in Chapter V. to mechanical agitation, and first of all gives at some length an account of the investigations of Haworth at Sheffield, and of their outcome, and then makes reference to plants worked on the Haworth or bio-aeration, system at Sheffield, East Ham, and Glasgow. Then in Chapter VI. he describes the "Simplex" system of mechanical agitation, which is associated with the names of Bolton of Bury, and of the Ames-Crosta Engineering Company, of Nottingham, and which is in operation at Bury, Bolton, Prestolee, Macclesfield, Epsom, Paris, &c. Other methods of mechanical agitation are dealt with in Chapter VII. First of all comes the "Low Power" process of Honeysett, then the "Aersedcon" method of Hilder Daw, and finally the "Spiral-flow Stage" process of Hartley. A summary of Ministry of Health Reports on the progress made with the activated sludge process in England is given in Chapter VIII.

In Chapter IX. the author directs attention to various places in the North American Continent where the process has been adopted. An account is first given of the very extensive works at Milwaukee—where Chalkley Hatton was a very early investigator—and then follow references to the installations at Houston, Texas, and at Worcester, Mass., Indianapolis, Chicago, and Toronto.

Concerning the different theories which have been evolved regarding the activated sludge process, Mr. Martin, wisely, limits himself to quite short comments. "The activated sludge process involves," he remarks, "a number of factors, physical, chemical, and biological, some of which are very imperfectly understood. Many influences are at work in the sewage; and their relative importance is not as yet clearly apparent. The paucity of definite information with regard to the underlying principles of the process is reflected in the widely divergent views which are prevalent as to the best mode of carrying it into effect." In Chapter X. numerous theories are set out at some length, but it is difficult to tell, in many cases, which the author accepts and which he rejects. Much the same remark can be made regarding Chapter XI., which is concerned with the requirements of process, and in which such subjects as "Velocity of Circulation," "Period of Aeration," "Quantity of Air," "Proportion of Sludge," "Continuity of Agitation," &c., are dealt with, though regarding the re-aeration or reconditioning of the sludge the author is more outspoken.

"Need for Preliminary Treatment" and "Alternative Modes of Working" are the subjects of Chapters XII. and XIII. respectively; while diffusers, diffuser troubles, &c., are discussed in Chapter XIV., and various designs of tanks used in connection with the process are described and illustrated in Chapter XV. The next two chapters, which treat of "Air Compression" and the "Loss of Pressure in Air Mains," might, we think, have been omitted without detriment to the value of the book. On the other hand, Chapters XVIII. and XIX., which discuss "Appliances for Mechanical Agitation" and "Power Required for Agitation," are quite short and might perhaps have been profitably extended.

Chapters XX. to XXV. inclusive, the subjects of which are "Comparison of Modes of Agitation," "A Combination of Methods," "Position and Outlook," "Cost of Process," "Reduction of Cost of Process," and "Factors Affecting the Cost of Power," respectively, are among the most valuable in the book and are well worth careful study, especially the last. In it Mr. Martin remarks:—"There is little doubt that the best hope for economy in power lies in so designing the aeration tank and so arranging the circulation that the *minimum* velocity required to prevent the deposition of sludge may be obtained with as low an *average* velocity as possible—in other words, in securing an approximately uniform velocity of circulation in every part of the tank." Another excellent chapter is XXVI., which reviews "Possible Lines of Advance," though Mr. Martin is careful to make no very definite prophecy.

The longest and, possibly, the most important chapter in the book is No. XXVII., on "The Problem of Sludge Disposal," and in it the present state of knowledge regarding this puzzling problem is ably reviewed. The author, however, holds out no hope that a thoroughly satisfactory solution of it is even within sight. The utmost length to which he goes is to say:—"Should it be found practicable to dispose of wet sludge by direct application to land, one of the chief obstacles to the adoption of the activated sludge process will be removed."

The last chapter in the book contains references to various recent developments, and then follow five appendices concerned with:—"Particulars of British Plants Using Diffused Air;" "Particulars of British Plants Using Mechanical Agitation;" "Particulars of American Plants;" "Air Compression;" "Power Required to Overcome Surface Friction;" and, finally, "Bibliography." There is, too, an excellent index.

The book represents an enormous amount of research and labour, and certainly contains the best collection of data regarding the activated sludge process that we have seen. A noticeable feature is that abundant references to American experience are made.

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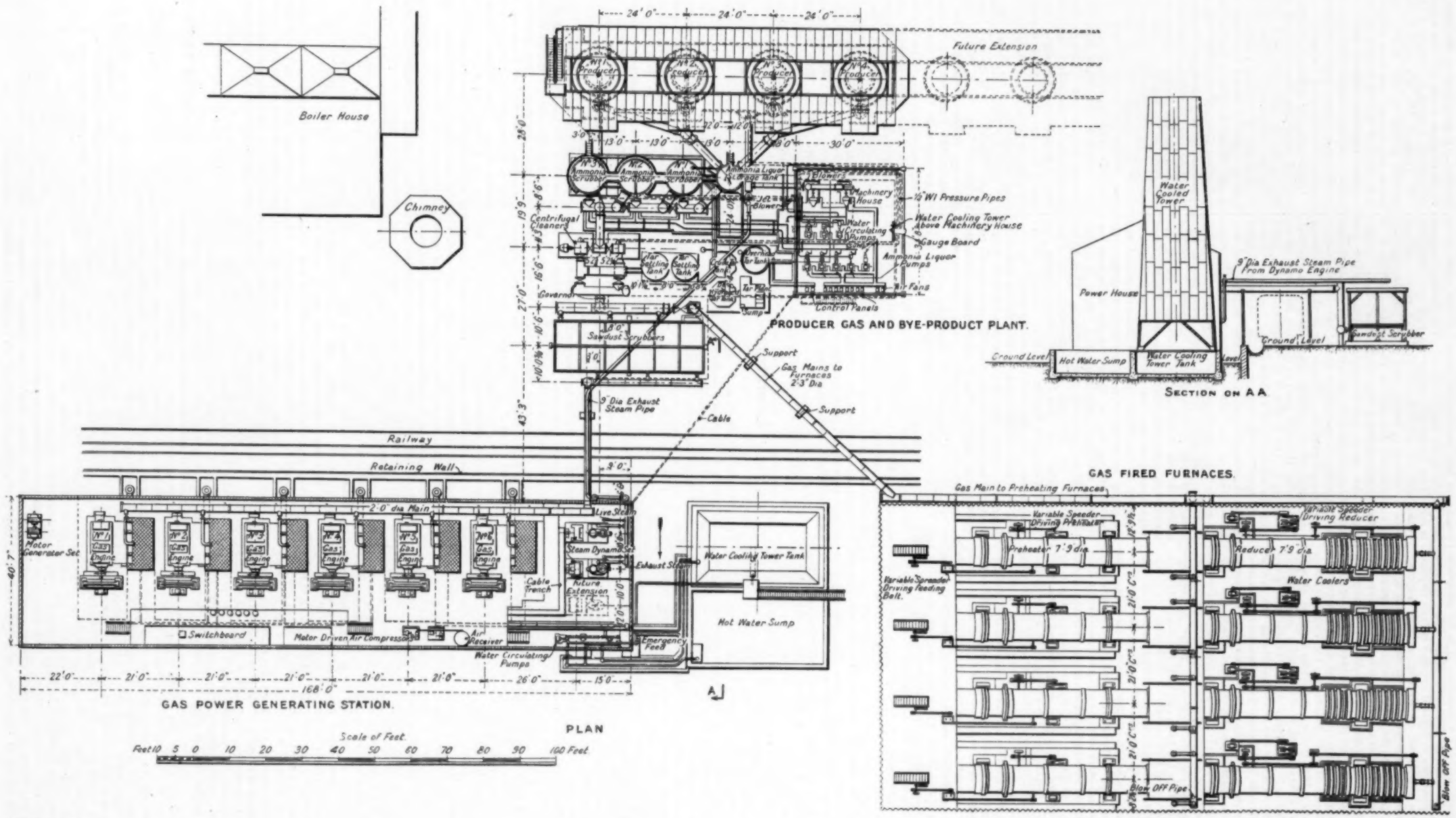
BYE-PRODUCT PRODUCER GAS PLANT IN NORTHERN RHODESIA

THE POWER GAS CORPORATION, LTD., STOCKTON-ON-TEES, ENGINEERS

(For description see opposite page)



A Bye-Product Producer Gas Plant at a Copper Works.

In the following article is described a bye-product gas producer plant which has been installed at a copper mine in Northern Rhodesia. The plant is interesting because the gas is employed for power and heating purposes, while the bye-products are used for obtaining the metal from the ore.

An extensive bye-product producer gas plant, supplied by The Power-Gas Corporation, Ltd., of Stockton-on-Tees, has recently been put into operation at the works of the Bwana M'Kubwa Copper Mining Company, Ltd., in Northern Rhodesia. It is claimed that, not only does the gas plant itself constitute a considerable advance on all other bye-product producer gas plants hitherto built, but that its particular combination with the mining and metallurgical equipment of the users is entirely novel and different from the usual copper mining practice.

The particularly isolated position—at an elevation of 4300ft. above sea level—of this copper mine, with regard to the supply of certain manufacturing requirements, necessitated careful scheming and planning when deciding upon the type of plant to install. The mine is situated on the Rhodesian side of the border between that country and the Belgian Congo, and is thus some 2000 miles away from the nearest harbour. The only way to get materials on to the site is by means of the railway, which is a single-track connection. Owing to the long distances between the various settlements in Rhodesia, the transport costs become high; so much so that the coal which is to be used in the factory, and which is obtained from the nearest coal-field, namely, Wankie, in Southern Rhodesia, costs five times as much as does the same coal in trucks at the mine.

Similarly, the processes adopted by the Bwana M'Kubwa Company for leaching the copper out of the ore requires ammonia, and as that ammonia could not be imported and delivered to site at a price less than £150 per ton—as compared with some £40–£50 in this country—it was decided that an ammonia recovery gas producer plant, capable of extracting the ammonia from the coal, would make a valuable combination.

The operations of the mining company require (*a*) power for driving machinery; (*b*) heat for the reduction and treatment of ores; (*c*) ammonia for leaching out the copper as oxide from the ore; and (*d*) tar of a quality suitable for readily reducing the oxide in the smelting furnaces, for painting and for roadmaking purposes.

As a result of five years' development work that The Power-Gas Corporation had carried out with its low-temperature gas producer plants, it was in a position to supply a complete equipment to meet the particular requirements of this undertaking, and the whole of the gas plant now at work has been supplied by it, and, in addition to providing the gas and bye-product plant, the company has acted as engineer for the power scheme and advisor on the gas heating applications. A drawing showing the arrangement of the plant is given on the opposite page.

Compared with the pre-war types of gas producers and when using the same coal and making about the same amount of ammonia, The Power-Gas Corporation's process is claimed to possess the following advantages:—(1) Capital costs of plant for same duty, about 40 per cent. less; (2) steam used for gasification, about 55 per cent. less; (3) number of men required for operation, about 30 per cent. less; (4) thermal efficiency of gas producer, about 20 per cent. higher; (5) the tar yield is of an oily character and about 200 per cent. higher; (6) calorific value of gas uniform and about 25 per cent. higher.

The gas is used for two purposes—power and heating. After cooling and cleaning, some of the gas is converted into electric power, the quantity required being on the average some 25 per cent. of the total output of the gas producer plant. The gas used for furnace heating is not cleaned so extensively as that for power production, and is used in the metallurgical department with two definite objects in view, namely, (1) the preheating of the ore, (2) the reduction of the same. The preheating is carried out in revolving furnaces, in which crushed and disintegrated ore is fed in at one end and is put into intimate contact with a current of hot gases passing through a revolving tunnel in the opposite direction. The ore gets preheated to a temperature of some 400 to 450 deg. Cent. and is then passed into another revolving drum furnace, in which it is put into contact with pure undiluted producer gas, air being absolutely excluded. The result is that a reduction process is carried out, the reducing agents in the producer gas, namely, carbon monoxide and hydrogen, attaching themselves to the reducible parts of the ore and bringing about a complete conversion of the copper—and also to some extent other metals—in the ore to the metallic state. This process of copper ore treatment is known as the Metals Production Process.

The spent producer gas leaving the reducing furnaces has a calorific value of about half of that which it had when leaving the producer, and in that state it is passed through a cooling and cleaning plant and mixed with the producer gas that is used in the preheating furnaces. Although the furnaces themselves were not supplied or made by The Power-Gas Corporation, Ltd., the company acted as advisor to the mining company in connection with the application of the gas to the two types of furnaces and in connection with the utilisation and recovery of waste gases from the reducing furnaces.

The ammonia is obtained from the producer gas plant as liquor—mainly as ammonium carbonate, and not as sulphate of ammonia, as in the Mond process. After special treatment it is made into practically pure ammonium carbonate liquor, which is a suitable solvent for copper oxide. The liquor in passing over the leaching vats, which are charged with crushed and reduced copper ore, absorbs the copper, which in its turn is removed from the ammonium carbonate liquor by evaporation and precipitation in a special plant, the stripped liquor being used over and over again for leaching purposes.

Although, at present, the unavoidable loss of ammonia, incurred in passing through this leaching and precipitation cycle, is higher than was contemplated, it is fully expected that, ultimately, it will not considerably exceed that obtainable by the ordinary operation of the gas plant, and that would make the whole installation independent of outside ammonia supplies.

The tar being of a low temperature type and of low water content, is used for painting and roadmaking or as a reducing agent for the copper oxide in the smelting furnaces, the tar being added to the oxide precipitated from the leaching liquor and well mixed with the oxide to make it more suitable for use in the reverberatory furnace.

The complete installation—see page 234—consists of four 10ft. diameter L.T. type gas producers with cooling and cleaning plant arranged for the recovery of ammonia liquor of 0·5 per cent. strength and for the removal of tar oils, which are dehydrated after removal. The gas used for the engines is scrubbed in sawdust scrubbers before it passes to the power-house, while the remainder is passed to the metallurgical furnaces. The power-house contains six Premier gas engines—rated at 550 B.H.P. at sea level—to the fly-wheels of which are bolted the rotors of six separately excited three-phase 600-volt 50-period 300-kW British Thomson-Houston alternators. The maximum load output under existing conditions is 1500 kW, one of the generating sets being a spare.

The gas engine power station is, we understand, large enough to meet all prospective requirements for gas power, inasmuch as steam extraction turbines operating with steam used in the evaporating and metallurgical plant will be put in for additional power generation. Steam is generated at a pressure of 140 lb. per square inch and used in the metallurgical plant at some 35 lb. per square inch. The steam turbine generators contemplated will be arranged to work in parallel with the gas engine alternators.

The alternating current developed by the power station is used for (*a*) handling and crushing the ore, (*b*) operating the rotary furnaces, (*c*) pumping solutions, (*d*) operating air compressors, (*e*) driving machine shops and supplying lighting, water, &c., throughout the mine and township. Owing to the simpler speed control of direct-current motors at varying loads, the whole of the electric power required for operating the power gas plant auxiliaries and for exciting the alternators is provided by one 180-kW 440-volt direct-current Belliss-Morcom and B.T.H. steam dynamo, operating on the three-wire system, a spare 180-kW set being installed.

The steam used for driving the direct-current generating sets, which is only a small part of the total, is obtained from a Babcock boiler battery which also supplies the steam for distilling the leaching liquors and for other purposes. The exhaust steam from these steam dynamos is passed to the gas producers and is more than sufficient for supplying their complete steam requirements. This method of combined power generating and producer supply is therefore very economical when viewed from the point of view of the gas producer plant *per se*.

All the alternator, direct-current generator, exciter and direct-current and alternating-current power distributing panels are centralised in one switchboard gallery in the power-house, and were supplied, with all cables, by The British Thomson-Houston Company, Ltd., to The Power-Gas Corporation's specification.

The producer gas plant is equipped with modern apparatus for its scientific control and operation. The temperature and saturation of the blast entering the producers is easily kept to the figure the plant manager may desire. The pressure of the gas at the producer outlets is maintained constant at about atmospheric pressure throughout the usual variation of load on the plant. The pressure of the gas at the point where the process gas and the power gas divide is also automatically governed to maintain it constant through wide variations of load, and, in addition, a non-return valve, combined with explosion doors on the process gas main, forms a safeguard against the gas engines creating a suction on the furnace gas main. An automatic gas recording calorimeter is installed at the plant outlet to keep a permanent check on the calorific value of the gas made.

The gas cooling and cleaning plant consists of one primary dust washer, in which the gas is cooled down to a saturation temperature, and has all its dust removed before it enters into an intensive gas condenser of the vertical tubular type. The ammonia is finally washed out in three Lymn type static ammonia absorbers arranged in series. From the ammonia absorbers the gas passes through two special high-speed gas cleaning fans, in which the tar is removed by centrifugal action combined with water washing.

The tar is handled by gravity until it reaches the dehydration plant, the water cooling tower for the primary gas cooler, together with the two gas fans, being raised well above ground level in order to permit of this. A tar dehydrating plant is provided to reduce the water contained in the tar to below 4 per cent. and to remove the dust. The plant consists of a primary tar settler of special design to remove the bulk of the water, and combined with it is a tar centrifuge to complete the dehydration and to remove solids. All the pumps and air blowers and gas fans are electrically driven and are controlled from the machinery house, "stop" buttons being also fixed at the gas fans for emergency use.

The power-house is equipped with apparatus for the scientific control of the plant operation, including the usual ammeters, voltmeters, wattmeters, power factor meters, frequency meters, synchronisers, &c. There are also a special motor generator set and a Tirrill automatic voltage regulator to maintain the voltage constant even with wide variation of load, and there are automatic means for cutting out of circuit any alternator on which a field fault develops. Static balancers are provided for the 180-kW three-wire dynamos. They are designed to balance 25 per cent. out-of-balance current.

Automatic means are also provided to ensure that the gas plant auxiliaries are, in the event of accident, not deprived of power until the whole of the other power-using appliances are cut out of circuit. This is an important provision, as the gas plant is the prime mover for the whole factory. In order to safeguard the gas engines from temporary failure of the cooling water circulating system an automatically operated "stand-by" cooling water connection is made to this system from the main water supply of the mine.

The ammonia gas and power plant has been in successful operation for a considerable time and is a good illustration of the adaptability of gas to modern factory requirements where heating is a factor to be considered in conjunction with power requirements. Various views of the plant are given on page 230.

Lloyd's Register Scholarships.

The Institute of Marine Engineers has just issued the following information regarding Lloyd's Register Scholarships and Student Graduate Examinations:—

Lloyd's Register Scholarships are three in number, one being available each year for three years at £100 per year. They are bestowed by Lloyd's Register of Shipping.

Application should be made by intending candidates not later than March 10th, 1928, in order that arrangements may be made for the examination, on the dates announced below. The examination will be held simultaneously in the various centres to suit the residences of candidates.

The regulations, with lists of subjects on which questions will be set, are as follow:—I. The scholarship is open for competition to candidates who are British subjects—that is to say, of British parentage in its Imperial sense—graduates, student graduates or associates of the Institute of Marine Engineers, apprentices or junior engineers (not necessarily connected with the Institute), the age limit being from eighteen to twenty-three at the date for entering the University. Preference will be given, in the event of nearly equal marks, to the candidate who acquits himself best at the subsequent oral examination before a special committee. The successful candidate, if not already associated, must join the Institute in the grade for which he is qualified. II. The scholarship is intended to assist marine engineering students, desirous of gaining higher attainments, better to qualify themselves for the duties of life in their profession. An undertaking must be given by the successful candidate that he will continue his studies for the full period of the term, extending over three years, with a view to the B.Sc. degree. III. The examination papers will be set from and based upon the following subjects, and the award will only be given in the event of a candidate showing sufficiently good qualifications.

May 8th, 10—11.30, Monday:—(*a*) Arithmetic; algebra to quadratics and progressions; May 8th, 11.30—1, Monday:—(*b*) hydrostatics and thermodynamics; May 8th, 2—3.30, Monday:—(*c*) geometry, based on Books I., II., III. and IV.; May 8th, 3.30—5, Monday:—(*d*) general knowledge, English composition; May 9th, 10—11.30, Tuesday:—(*e*) applied mechanics; May 9th, 11.30—1, Tuesday:—(*f*) foreign language—choice given to the candidate who is required to notify this on his application—elementary construction and translation; May 9th, 2—3.30, Tuesday:—(*g*) trigonometry, including logarithms; and May 9th, 3.30—5, Tuesday:—(*h*) practical engineering.

As the object of the scholarship is to provide means for young engineers to add to their proficiency as marine engineers, only those are eligible who have served at least two years in a commercial engineering workshop, and until the time of application have been employed at engineering, either ashore, afloat, or at College, with the intention of entering upon the business of marine enginering, but not necessarily to remain a sea-going engineer. Subject to the approval of the Council, the successful candidate may choose the university or college most convenient to himself, but he must take all the classes in the recognised curriculum for engineering students at the university or college chosen.

Student Graduates:—Applications to sit at the examinations will be received till March 3rd, 1928. The dates for the examination are:—April 17th, Tuesday—10—1, theoretical mechanics; 2—5, heat and heat engines; April 18th, Wednesday—10—1, machine construction and drawing; 2—5, applied mechanics; April 19th, Thursday—10—1, mathematics, including geometry; 2—5, English language including composition; and April 20th, Friday—10—1, electrical engineering.

Further particulars may be obtained on application to Mr. James Adamson, hon. sec., the Institute of Marine Engineers, 85-88, The Minories, Tower-hill, London, E. 1.

The Changing of Tappings on Loaded Transformers.

In a series of articles on alternating-current pressure regulators published in The Engineer last year, we described all apparatus of that nature made in this country at that time, and in the third article, which appeared on April 30th, 1926, we gave the views expressed on the subject by Mr. H. C. Albrecht in a paper read before the American Institute of Electrical Engineers. It will, perhaps, be remembered that Mr. Albrecht favoured transformers with tappings that can be changed under load, and that in his paper he described the application of equipment of this nature to the interconnection of certain power stations in America.

Although it is probably realised by most electrical engineers that when it is necessary to change the voltage of transformers under load, the tapping changing method is the cheapest method that can be adopted, the design of apparatus of this description has been somewhat neglected by the majority of British transformer manufacturers. Other methods of varying the voltage have consequently been adopted, but in view of the proposals to interconnect power stations on an extensive scale and the rapidly increasing use of alternating current for general purposes, it is not surprising to find that transformer makers are beginning to devote attention to the design and construction of tapping-changing gear that operates on the main transformer windings, whilst the transformer is at work, and which, apart from being relatively cheap, also offers the advantage of occupying a small amount of space, thereby lowering the cost of sub-station buildings. Other advantages claimed for these transformer equipments are low cost of cabling and erection, high overall efficiency and high speed of operation.

Three 12,000 kVa transformer banks, with a ratio of 10,500/22,000 volts, equipped with ingenious gear for changing the tappings under load, have recently been built by Ferranti, Ltd., of Hollinwood, for the London Power Company, and we believe that we are correct in saying that these are the first transformers in this country to be controlled on this system. As shown in the diagram, Fig. 1, the windings are connected in delta-star fashion, and the voltage ratio is changed under load, so as to give

a boost of 8 per cent. in steps of 2 per cent. It will be seen that on the 22 kV side, there are double paralleled connected windings, so that normally each winding carries half the total current. When it is desired to change the voltage ratio, however, the circuit of one of the windings is opened by means of a quick break oil switch, called a series switch. The tapping on this winding is then changed, the total load current being carried during the very short period of time required for this operation by the other winding. The series switch is then closed again, when the same operation is carried out by another series switch on the other primary winding. By the operation

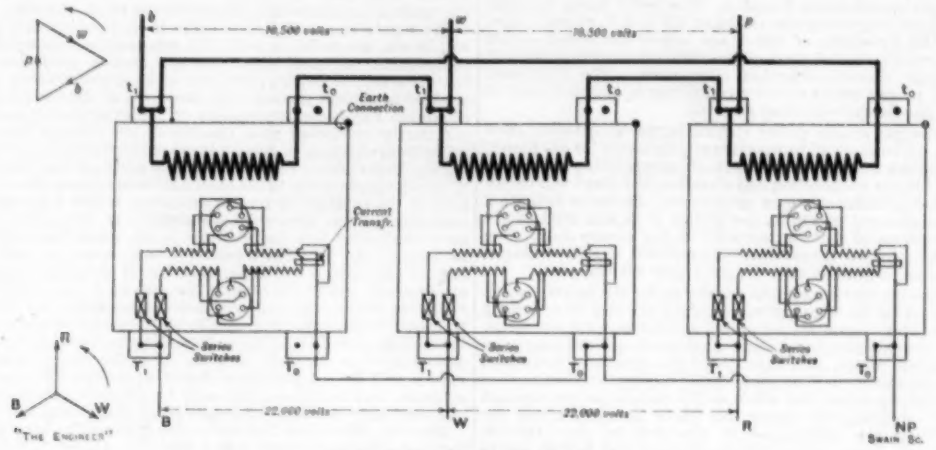


FIG. 1.—TRANSFORMER CONNECTIONS

of the series and tapping switches in the proper sequence, the voltage is therefore changed without interrupting the supply to the system.

The equipments supplied to the London Power Company are electrically controlled from a distance, and as the transformers work in parallel, the control gear—see Fig 2—has been designed so that the three banks of transformers can be regulated with one controller. Automatic operation can be provided, but in the case of this particular installation it was not called for. Any one of the equipments can, of course, be operated by hand.

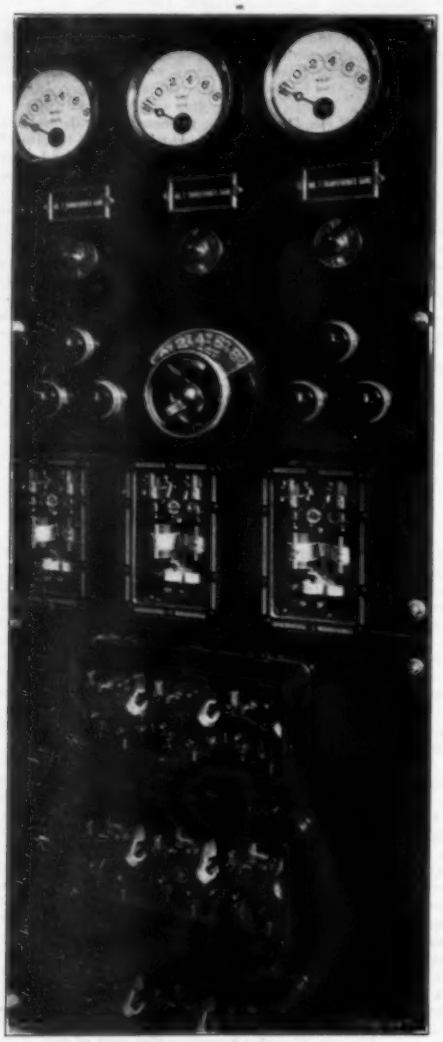


FIG. 2—CONTROL PANEL

The range of boost and the number of steps required on these transformers made it possible to use the standard Ferranti tapping switches, which, as shown in Fig. 3, are mounted close to the windings. When the range of boost and number of voltage steps required precludes the employment of these standard Ferranti tapping switches, use is made of a multi-way radial switch, which possesses the same desirable features as the standard switch. The series switches, which are to be seen in Fig. 4, are quick-break oil immersed switches, fitted with sparking contacts. For operating all the switches in the correct sequence cams and gearing are employed, the gearing being enclosed in a dustproof casing filled with oil.

The control switch—see Fig. 2—is a hand-operated rotary switch having a contact corresponding to each of the regulator positions, and it is electrically interlocked, so that it cannot be moved whilst the tap changing mechanism is in motion. When the control switch is moved to a new position, the control relay of the regulator immediately causes the latter to respond and to take up a position corresponding to that of the control switch, the control being more positive than that obtained with push buttons. Simultaneous operation of the tap changing equipments is ensured by the use of the common control switch, but in order to allow of individual operation, three pole switches are also provided on the control panel, so as to enable the control circuit of any one of the transformer banks to be put out of action. Before a bank is switched in, however, the mechanism ensures that it will take up the same boosting position as that of the other bank, with which it operates in parallel. Remote indication of the position of the regulator is given on the control panel by an indicator in the form of a voltmeter supplied from the control auxiliary circuit through a potential divider operated by the tap-changing mechanism. The voltage applied to the indicator varies in steps with the position of the tap changer the indicator dial being scaled accordingly, and an "off" position indicates when there is no voltage on the indicator circuits. For its operation this form of indicator only requires two wires, and it is therefore cheaper to install than the usual form of lamp indicator, and it is also more reliable. On the tap-changing mechanism at the transformers a mechanically operated indicator is provided, and limit switches prevent any movement of the gear beyond the extreme step in either direction.

As will be seen from Fig. 4, the tapping switches are fixed inside the transformers at the level at which the coils are tapped, with the result that it is unnecessary to bring the tappings out of the transformers or to cleat the connections between the tapped coils and the switch contacts. Moreover, as the switches do not break any load, there is no danger of carbonisation of the oil taking place within the transformers. The series switches are contained in sheet steel tanks mounted outside the main transformer cases, as shown in Fig. 3, the main transformer connections being taken through bushings in the side of the transformer tank direct to the switches, thus keeping all the connections under oil. For lowering the oil switch tanks, gear is provided, as shown in Fig. 3, from which it will be gathered that the contacts of the switches can be examined, with very little trouble. Tendency for the contacts to burn and for the oil to carbonise is very small, since, owing to the clearances necessary for 22,000-volt working, the breaking capacity of the switches is very much greater than the kVA with which they ordinarily have to deal, which is only a small percentage of the full load. Inspection covers give easy access to the connections to the series switches, so that they can readily be disconnected when it is desired to remove the transformer from its tank.

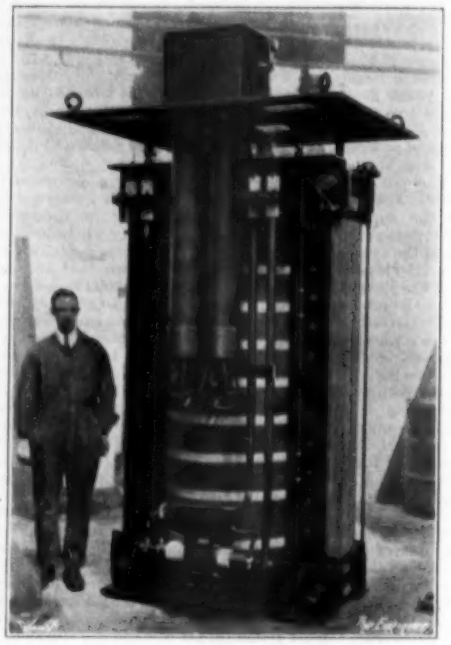


FIG. 4—TRANSFORMER REMOVED FROM CASE

The mechanical gear for operating the switches is mounted on the cover of the transformer tank, and the cover and the transformer can be lifted out as one unit. Removable covers enable access to be gained to all portions of the mechanism. In the case of these particular transformer banks supplied to the London Power Company,

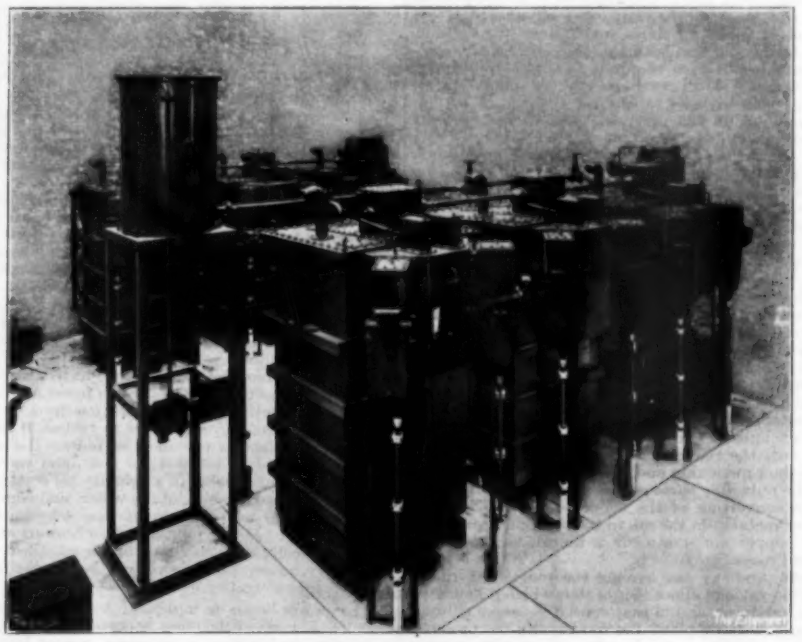


FIG. 3—THREE-PHASE TRANSFORMER BANKS

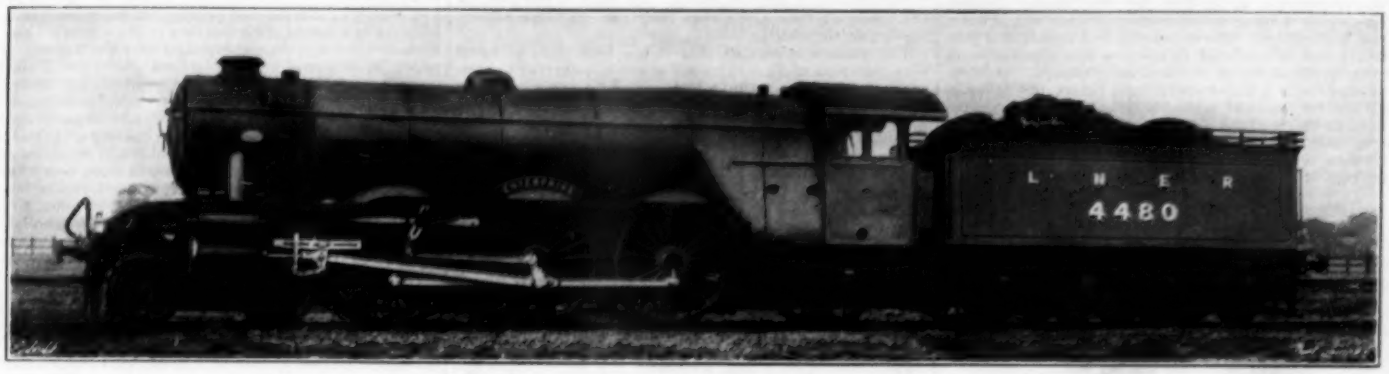
outdoor equipment was not called for, but, if necessary, the whole of the gear can be made for outdoor operation.

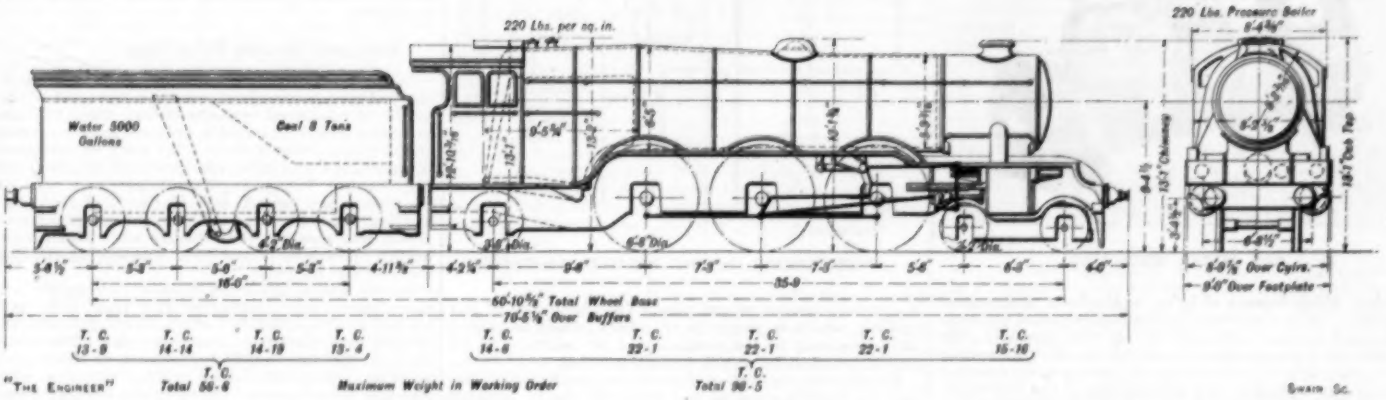
From the foregoing description, it will be perceived that great care has been taken to design all the operating gear, so that it can easily be inspected and maintained without having to lift the transformer out of its tank, and consequently the design is quite suitable for outdoor work. In order to provide against failure of the auxiliary supply preventing the tap changer from completing a full movement, and thus overloading a portion of the winding, differential current transformers are provided in the parallel connections at the bottom of each limb, as shown in Fig. 4, the secondaries of these transformers being connected to a relay having a time lag sufficient to prevent operation during the normal working of the tap changer. The relay can be arranged to give an alarm and to trip one or both of the main transformer switches.

The time taken for the gear to give a change of voltage, measured from the instant the control switch is closed, to the moment of a completion of a voltage step, is less than two seconds, whilst measured from the time of opening

L. AND N. E. RLY. LOCOMOTIVE WITH HIGH-PRESSURE BOILER

MR. H. N. GRESLEY, M. INST. C.E., LONDON, ENGINEER





L. and N.E. Rly. Locomotive with High-pressure Boiler.

With the object of finding out more about high-pressure boilers by actual experience, Mr. Gresley is constructing several to work at 220 lb., and is putting them into engines which come into the shops for general repairs. One of the engines so fitted is shown above, both by a reproduction of a photograph and by the weight diagram. The appearance of the engine has been changed very little, the external dimensions of the boiler being almost the same as heretofore. The barrel plates are, of course, thicker, and a larger superheater has been fitted—one with forty-three in place of thirty-two elements—with the result that the engine weighs 3 tons 16 cwt. more than the 180 lb. engines of the same class. The distribution of this increased weight upon the wheels is interesting. In their original form the engines had 17 tons 1 cwt. on the bogie; they now have only 15 tons 16 cwt. On the trailing wheels they had 15 tons 8 cwt., and have now only 14 tons 6 cwt. But in place of the 20 tons on each of the driving axles, the load is now 22 tons 1 cwt. The whole engine now weighs 96 tons 5 cwt. in working order, as against 92 tons 9 cwt. It is the adoption of three cylinders and the consequent reduction of "hammer blow" that has made the augmented axle load possible, for the engineers of the line are satisfied that the road and the structures will take the increased weight without suffering.

The engine is, of course, made more powerful by the increase of pressure, and with 85 per cent. of the boiler pressure the starting tractive effort has been raised from 29,835 lb. to 36,465 lb., but since the axle load has been at the same time increased, the factor of adhesion is not less than 4, which is desirable if slipping of the wheels is to be prevented.

We may add that the slight modification of the Walschaerts gear to give longer valve stroke which Mr. Gresley is introducing as occasion serves has been made in this case. The superheater, to which reference has already been made, originally consisted of four rows, each row consisting of eight flue tubes. In the new arrangement there are five rows, the top row having seven flue tubes and the others nine each.

These engines will be worked over the Southern, North-Eastern and Scottish areas of the London and North-Eastern Railway, so that comparative data with the lower-pressure boilers may be obtained. In this way facts as to maintenance costs, the life of five-boxes, stays and tubes will be secured, and at the same time it will be possible to ascertain definitely what economy can be secured by the use of higher pressures. The experiment, being directly comparative, should be exceptionally interesting and valuable.

We give below a table summarising the differences between the original 180 lb. and the present 220 lb. engines:—

Boiler pressure	220 lb.	180 lb.
Tubes—Number	125	168
Outside diameter	2¼in.	2¼in.
Flues—Number	43	32
Outside diameter	5¼in.	5¼in.
Heating surface—		
Fire-box	215 sq. ft.	215 sq. ft.
Tubes	1,398·8 sq. ft.	1,880 sq. ft.
Flues	1,122·8 sq. ft.	835 sq. ft.
Total evaporative H.S.	2,736·6 sq. ft.	2,930 sq. ft.
Superheater—		
Number of elements	43	32
Heating surface	706 sq. ft.	525 sq. ft.
Total heating surface	3,442·6 sq. ft.	3,455 sq. ft.
Grate area	41·25 sq. ft.	41·25 sq. ft.
Cylinders (three)	20in. dia. by 26in. stroke	20in. dia. by 26in. stroke
Tractive effort at 85 per cent. boiler pressure	36,465 lb.	29,835 lb.
Total adhesive weight	148,176 lb.	134,400 lb.
Adhesive weight—		
Tractive effort	4·06	4·5
Weight of engine in W.O.	96 tons 5 cwt.	92 tons 9 cwt.
Weight of tender in W.O.	56 tons 6 cwt.	56 tons 6 cwt.

3in. Cast Steel Cable Chain.

Chains in iron have been known practically since that material was first forged, and they have all, of course, been liable to the human element in the weld necessary in every link. The softness of the material to ensure that as perfect a weld as possible shall be made has, to a considerable extent, affected their useful life. Proposals have been made from time to time to manufacture these chains in cast steel.

These proposals interested the Admiralty, and various firms endeavoured to solve the problem experimentally. Finally William Beardmore, of Glasgow, were successful in producing a finished cast steel chain which would pass the rigid test requirements laid down. The specification called for a 12½-fathom 3in. cast steel stud link chain, with the necessary shackle. A testing length was to be selected by the inspector anywhere from the finished chain and subjected to the following tests:—Shock test: Two single links each to stand fifteen blows with a 1-ton tup without sign of fracture as follows:—Two blows at 10ft., two blows at 15ft., and eleven blows at 20ft. A three-link sample from test length was to stand without sign of fracture a proof load of 204 tons, the overall elongation not to exceed 1in. at that load. The sample was then to be loaded till fracture occurred, and to give a breaking load of not less than 306 tons. The whole chain was then to stand a proof load of 204 tons.

The high standard required can be understood by considering beside these figures the corresponding tests required on a standard 3in. wrought iron cable chain, which are:—Tup test, nil; proof load, 145·8 tons; breaking load, 218·7 tons. It will be noticed that the proof load stipulated for the cast steel chain is very nearly the breaking load accepted for the wrought iron chain.

After the various manufacturing difficulties inherent to a proposition of this nature were overcome a complete chain was manufactured for the Admiralty which fulfilled all the test requirements of that body. This chain is at present in service, and the result of its performance is awaited by its manufacturers with confidence.

The test results as taken by the Admiralty are as follows:

Tensile Test Result.—36·5 tons per square inch, 25 per cent. elongation, 180 deg. bend, W.F. Proof and breaking loads were applied to the three-link sample and the completed chain at Lloyd's Proving House, Netherton, on June 11th, 1926. They are as follows:—Three link sample, proof load of 204 tons applied, no fracture; total elongation, 19/32in. Load increased to 306 tons, no fracture; total elongation, 2¾in. Load further increased to 385 tons, not broken. Load further increased to 400 tons, not broken; total elongation, 6¾in.

As 400 tons is the maximum testing capacity of the machine, it was not possible to break this sample, and no other testing machine is available for this purpose.

Tup Test Result.

Link No. 1, 1-ton tup. Height. ft.	Elongation. in.	Link No. 2, 1-ton tup. Height. ft.	Elongation. in.
10	1/32	10	1/32
10	1/16	10	1/16
15	1/8	15	1/8
15	3/16	15	3/16
20	1/4	20	1/4
20	1	20	1/2
20	1¼	20	1¼
20	1 7/16	20	1½
20	1 7/8	20	1½
20	1½	20	1½
20	1 11/16	20	1 11/16
20	1¾	20	1¾
20	1 15/16	20	1¾
20	2	20	2
20	2⅛	20	2⅛
Sound. Total elongation 2⅛in.		Sound. Total elongation 2⅛in.	

Completed Chain.—The Admiralty proof load of 204 tons was applied without fracture. The total extension of the chain at that load was 15¼in., measured on a length of 73ft.

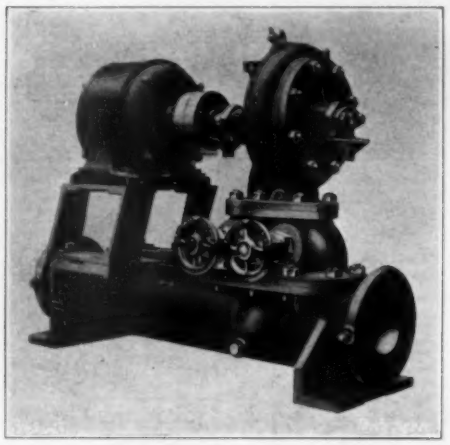
The method adopted in casting has, Messrs. Beardmore inform us, ensured perfect solidarity in the links, a number of which have been sawn up across all sections and have been found free from defects.

In his annual report, Mr. R. E. Kimens, Commercial Secretary to H.M. Legation, Warsaw, says: There are four Government wireless telegraph stations in Poland. With the exception of one, however, the equipment is of an obsolete pattern; owing to the policy of economy followed by the Government, it is not proposed to improve these plants at present. Broadcasting has developed rapidly during the last two years. The first broadcast station was opened at Warsaw in 1925; three others, at Krakow, Katowice and Poznan, are in course of erection. The number of receiving licences has risen from 5000 in 1925 to 47,000 at the end of 1926, and a further increase is expected on the opening of the new stations. The demand for wireless sets is, consequently, growing daily, and the prospects for the sale of foreign accessories and equipment, but not completed sets, are favourable, as they are not manufactured locally. The standing of the wireless dealers is also tending to improve.

Circulator for Hot Water Heating Systems.

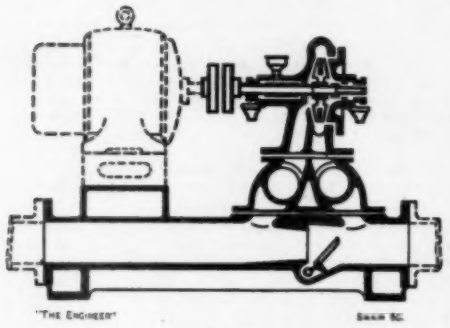
The accompanying illustrations represent a motor-driven circulating apparatus for hot water heating systems which is being introduced by Holden and Brooke, Ltd., of Manchester. The apparatus is compact and self-contained and is intended to obviate the disadvantages common to other forms of circulating pumps. It comprises essentially a Sirius centrifugal pump, the cover of which can be removed without breaking any hydraulic connections and without disturbing the motor or coupling, so as to render the internal examination easy.

The base of the pump is flanged and ported to correspond with a similarly shaped flange on the main base



HOT WATER CIRCULATOR

casting, which instead of being in the form of the usual bed-plate, takes the form of a standard length of the main hot water piping in the circuit. In this pipe bed-plate is included a non-return valve which hangs off its seating when the pump is inoperative and consequently does not offer any resistance to the gravity flow of the hot water. The suction and delivery ducts to and from the pump lead from either side of this valve, so that when the set is put into operation the valve is at once closed and held closed



ARRANGEMENT OF CIRCULATOR

and the water is caused to circulate through the pump as if on a by-passed circuit.

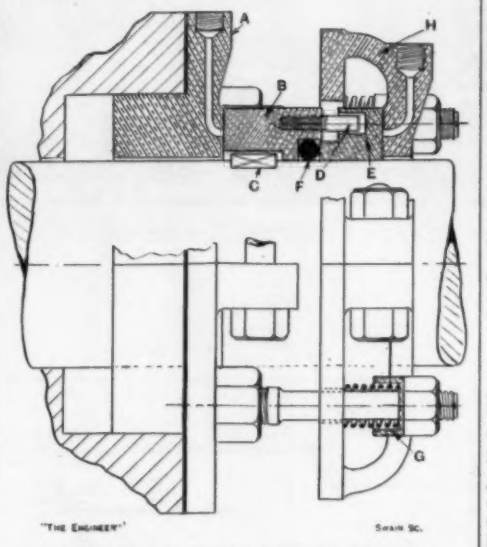
In case the pump accidentally ceases to work, owing, for instance, to the failure of the electricity supply, or is definitely shut down for cleaning or repairs, the valve again falls open and allows the normal gravity flow to continue. It will be noted that each duct in the base casting contains a plug cock which acts as an isolating valve, but if these cocks are not necessary a blank flange can be provided for fitting over the facing on the base. Before that can be done, however, the whole unit must be isolated temporarily and valves must be fitted in the pipe line on each side of the set.

A New Rotary Metallic Packing.

A new type of rotary metallic packing has recently been patented and put on the market by the Regulator Metallic Packing Company, Ltd., of 37, Moorfields, Liverpool, which has given to it the name of the "Regulator" packing. It is illustrated in the accompanying engraving, and, in the form there shown, it is specially intended for use with low-pressure centrifugal pumps for marine and land work. The design is, however, capable, so we understand, of being modified for use with high pressures and also for the stern glands of propeller shafts.

As will be observed from the drawing, the packing comprises, first of all, an annulus A, which is attached by studs to the flange of the pump. We may say, in passing, however, that the arrangements are such that should the special packing, which we are about to describe, fail, the annulus can be used to compress soft packing in the stuffing-box in the ordinary way. Butting up against A is a first ring of metallic packing B, which is made to rotate with the shaft by the key C, which is let into the shaft. Screwed into the packing ring B are pins D, which enter corresponding holes in a second ring of metallic packing E, which consequently revolves with the ring B. Between the rings B and E is inserted a single turn of soft packing F. The two rotating parts B and E are kept in contact with and compress the soft packing F, because the springs G tend to force down the plate H which abuts against the outer face of the ring E. The plate H is made in the form of a cupped cap, so as to keep the overall length of the packing as short as possible. Lubrication between the rubbing surfaces is effected by means of oil or grease applied through the ways, which, as will be seen, are formed in the annulus A and the cap H. All parts of the packing are made in halves, so that they can be conveniently applied to the shaft.

The makers inform us that it has been demonstrated that packings of this type will remain quite tight, even when the shaft is running a little out of line, or when there



"REGULATOR" ROTARY METALLIC PACKING

is a certain amount of end play. The single turn of soft packing, which is generally of rubber, tends to give a slight resiliency to the packing, and the latter is, so we gather, found to be very flexible in practice.

We may add that one of the main objects for which this type of rotating packing was designed was to prevent wear on pump or propeller shafts when fitted on ships, which have to operate in rivers or estuaries where water containing sand or grit may be encountered. Apparently, this object has been fully achieved, for we are assured that no wear of any kind has been observed on shafts fitted with this type of packing.

South African Engineering Notes.

Move in Rubber Manufacture.

The extensive works of the new Transvaal Chemical Company, Ltd., at Delmore, 2 miles east of the important railway junction and industrial centre, Germiston, Transvaal, were acquired some months ago by the South African Rubber Manufacturing Company, Ltd., which owns the Induna Rubber Mills, Howick, Natal, covering 14 acres. These mills have been in existence for years and supply goods equal to the imported article, and constant demands of mines, railways and industries keep them going night and day. The Delmore property, which the company has acquired, is 53 acres in extent, includes large buildings, sheds and offices, railway sidings, plant, electric power, water installation, and other kinds of equipment, and a modern village with sports grounds, recreation rooms and vacant land for industrial, trading, and residential purposes. A sum of nearly £200,000 has been spent on the property. Business was begun thirty-five years ago by the late Dr. Schlesinger-Delmore. At first the works treated only refractory gold ores, but later the manufacture of sulphuric acid, hydrochloric acid, soap, candles, and other allied chemical products was undertaken. Most of the acquired area is occupied by candle, soap and grease works with their auxiliaries.

The board of directors of the New Transvaal Chemical Company decided upon the sale of the property because the company had profitably disposed of certain of its main manufacturing activities and its large investments and share holdings in other industrial concerns, and did not require large works. The manufacture of soap, which is retained, can be more economically undertaken by the associated companies in Johannesburg.

Johannesburg's New Station.

The plans of the new railway station at Johannesburg, which is shortly to be proceeded with, show that it will constitute a dignified work of art. The area to be occupied by the station building and its quadrangles measures 530ft. by 210ft. There will be twenty-one platforms, or twice as many as at present. The construction of the new station will in no way interfere with traffic, and business for the next three years, while building is proceeding, will be as usual. Constructed principally of local granite and bricks, and with a tiled roof, the building will consist of four storeys and basement, with an attic in which the Railway Institute will be accommodated. Entrances to the station have been carefully designed to meet all needs and to avoid congestion. For instance, there will be large parking areas for cars outside and one entrance for the bulk of pedestrians and another for passengers arriving by motor cars. Baggage, parcels, cloak room, long-distance booking office, and publicity bureau are situated on the ground floor, but passengers joining trains will have to descend 12ft. lower, where, by a subway, they will pass beneath the lines and emerge by steps at the particular platform required.

The plans reveal a large central hall, built in concrete, after the Roman style, 200ft. by 100ft., with a dome-shaped vault, 60ft. span on the lower floor level. This will be used by the travelling public as a general waiting room and will be ventilated and lighted by natural means. The design of this pillared central hall with decorated roof is one of the outstanding features of the construction. An entirely new and desirable feature in the lay-out is the provision of a road on the platform which serves the mail and other trains arriving from long distances. Motor and other traffic will thus be able to approach practically alongside the trains in the heart of the station in order to take up passengers and strangers to the city and clear them away with the least amount of trouble and embarrassment. First-class passengers and others will have every facility in the way of waiting rooms, refreshment rooms, &c., on the floor adjoining the concourse hall, where, amongst other things, there will be a luxurious dining room calculated to be as large as anything in Johannesburg. A first-aid equipment room, with electric lift and other special accommodation for any sick or injured persons, will also be a part of this magnificent building. The main frontage will be of red granite from the Transvaal and the building will be carried to the top in South African bricks of a light yellow tone, the whole creating a pleasing design. The estimated cost of the scheme is £650,000, of which £350,000 will be accounted for by the station buildings. The difference in the figures will go to the construction of bridges, subways, trackwork, and the purchase of a strip of ground.

Reinforced Concrete Water Pipes.

A novel piece of water engineering, so far as South Africa is concerned, was the laying of a 13½-mile length of reinforced concrete piping, 24in. in diameter, to convey water under high pressure from the reservoirs of the Rand Water Board to the town of Johannesburg. When tenders were invited for the supply of pipes, specials, &c., for the Vereeniging-Zwartkopjes pipe line—which constitutes the second unit of the Vaal River scheme and has to deliver five million gallons per day—steel piping was specified, but tenders were also invited for reinforced concrete or cast iron. The total length of piping required was 140,000ft.

On the acceptance of the Hume Pipe Company's tender manufacture was commenced on a small scale with the machinery already at the factory, pending the installation of additional machinery and equipment. The new plant designed by the company consisted of three moulding units and six reinforcement making machines with 120 pipe and collar moulds. The moulding units were designed to spin four pipes at a time with an output of thirty-two pipes per machine per day, the speeds being arranged to give a maximum pressure due to centrifugal force of 16 lb. per square inch on the concrete. Each moulding unit was fed by a Victoria concrete mixer having a capacity of 1 cubic yard. The reinforcement machines were designed specially for the contract. To deal with the output of the new moulding units three new steaming chambers were provided, each of them taking the output from its respective moulding unit.

The total weight of pipes transported was approximately 7300 tons, and pipe laying was completed within the time stipulated. The pipe line was then filled with water and allowed to stand full for approximately one month, water being by-passed into the main from the existing steel pipe which runs parallel with the concrete main. The water was passed in at Meyerton and allowed to flow slowly through the pipe into the Zwartkopjes reservoir. The main was then closed down and the full static head pressure brought into operation at intervals. The general scheme of the test decided on was to close off a section of the pipe line about 11 miles in length, to fill that length under pressure from the steel main, and when it was considered that all air had been expelled from this section, to connect the two mains through a meter recording the amount of water passed into the new main, in order to maintain the pressure over a number of hours. It was thus possible to record the pressures over various lengths of the pipe line. In some sections the pressures were 100 per cent., while in others they varied from 50 per cent. to 90 per cent. of the normal working pressure. During the period that the 11-mile length of pipe line was under test the remaining length of approximately 2½ miles was subjected to a static head test. This remaining portion is that immediately connecting to the Zwartkopjes reservoir, and held about 278,730 gallons. The height of the water in the outlet chamber was read at the commencement and end of each period of test, and on each occasion a steady and progressive lessening in the loss was recorded. In terms of the contract the Hume Pipe Company had to maintain the pipe line for a period of twelve months. From November 27th, 1925, to November 26th, 1926, the pipe line delivered approximately 1,460,000,000 gallons of water, no work whatever having to be done to any pipe or joint in the whole installation.

Mineral Production.

The mineral production for the first four months of 1927 constituted a record, the value being £20,393,911, compared with £18,171,539 for the corresponding period of 1926. The following are the detailed figures, those for the corresponding period of 1926 being given in brackets:—Gold, £14,047,538 (£13,554,591); silver, £39,230 (£43,477); platinum, £74,431 (nil); osmiridium, £21,091 (£34,684); diamonds, £4,569,817 (£2,931,408); coal, £1,189,764 (£1,227,096); copper £187,327 (£180,634); tin, £123,008 (£101,476); and other minerals, £141,705 (£98,193). While gold showed an increase of about half a million, it was diamonds with an advance of £1,638,000 that so largely swelled the value, and that increase was entirely due to the great rise in the production of alluvial diamonds which resulted from the Government continually proclaiming as open for pegging areas of rich diamondiferous ground. The result was that the production from the alluvial diggings which used to be steady at rather under £2,000,000 per annum, rose to £4,000,000 in 1926, while for the first four months of 1927 it was at the rate of nearly £8,000,000 per annum. This figure so frightened the diamond trade that prices, except for the best stones, fell

seriously, the fall in some cases being as much as £5 per carat. The diamond industry adds millions to the revenue of the country—the Government share of the big Premier Mine's profit is 60 per cent.—and if diamonds dropped seriously in price it would be a very serious blow for the country.

A Million for Rolling Stock.

One of the largest orders ever offered for competition by the South African Railways in respect of rolling stock has just been officially detailed. Tenders are invited for the supply of 125 engines (and spare parts), including ten shunting engines, the remainder being largely of the "Big Bertha" type. It is estimated that the average cost of each will be about £8000, and on that basis the order would amount to £1,000,000. The locomotives are needed to replace wastage, to meet expansion in mileage, and the expansion of railway traffic. The tenders are returnable on October 13th in South Africa.

Air Service Contract.

The announcement of the Government's approval of the new commercial air services contract has caused general satisfaction. For the first two years the Government will pay a subsidy of £8000 per annum to the company, which is financed by the Allan Cobham Civil Aviation Company, Ltd., with British capital, and has the approval of the Air Ministry officials in London. Trips will be run each way between Johannesburg and Durban three times weekly for a start, the fare being £8 10s. for a single trip lasting four and a-half hours. A daily service between Durban and Maritzburg is proposed, the time occupied being half an hour. Taxi "trips," "joy rides," week-end trips in one and a-half hours to Port St. John's at a return fare of £6 10s. and a service to East London are also mooted. De Haviland four-passenger machines of the DH 50 type, with 350 H.P. "Nimbus" engines will probably be used, the pilots being Air Force Special Reservists obtained from within the Union. Mails and light freight will be carried in addition to passengers. The contract is for a period of five years, and the service is likely to commence early in 1928.

Railway Expenditure.

The railway estimates for the current financial year provide for considerable expenditure at Bloemfontein and Durban. At Bloemfontein £200,000 is to be expended for additional buildings and machinery for the local railway workshops. Of this sum £70,000 is earmarked for new carriage and wagon repair shops. A new sawmill, carriage and paint shop and equipment will cost £130,000, of which £58,336 will be spent this year. Another vote covers the relaying of the Bloemfontein–Bethlehem line with 80 lb. rails, at an estimated cost of £696,287. Durban's share of new work includes £176,000 for a new goods shed and cold-storage works at the Point; £54,693 for new electric cranes and capstans; £70,000 for a new tug in place of the Richard King; £7336 for widening and lengthening the Smith-street Bridge, at present a dangerous "bottle-neck"; £10,950 for a new station and yard at the important suburb of Red Hill, on the North Coast Branch Railway; £20,000 out of a total of £105,000 for the new Government offices at the corner of West-street and Aliwal-street; £9500 for a garage for post office vehicles on a portion of the old Lord's Grounds; and £5600 for a new pathological laboratory and office at the Observatory, Currie-road. No provision has, however, been made for additional deep-water berths at this port, the necessity for which is growing greater as time goes on.

Rand Water Scheme.

The Vaal River scheme of the Rand Water Board for the supply of water to Johannesburg and the Rand is to be further developed. It was originally divided into first and second units. The first unit comprised the supply of five million gallons daily to the Rand, and entailed building a barrage and laying down pumping and filtration plants at Vereeniging and pipe lines and new distribution links to make the water available on the Rand, a result achieved in July, 1923. The second unit was divided again into two portions. Portion A comprised the installation of additional pumping and purification plants at Vereeniging, and a duplicate pipe line from Vereeniging to Zwartkopjes, the Board's pumping station in the Klip River Valley. This portion was completed in August, 1926, at a total cost of £263,506. This renders an extra five million gallons a day available at Zwartkopjes, but the mains from there to the Rand are only capable of handling some fifteen million gallons a day, of which ten million gallons are available in the Klip River Valley. Portion B originally comprised the installation of additional pumping plant at Zwartkopjes, and a pipe line from there to the Board's Village (Johannesburg) Pumping Station. It has now been decided to proceed with this portion, but the new pipe line will run further direct to the Yeoville Reservoir. The cost is estimated at £186,000. Tenders for the plant and material have been invited. The plant at the Village Pumping Station will be overhauled and modernised at a cost of £7500, which sum will be provided from the reserve fund.

THE POLYTECHNIC ENTRANCE SCHOLARSHIPS IN STRUCTURAL ENGINEERING.—The Governors of the Polytechnic, Regent-street, London, are offering three entrance scholarships for the course in structural engineering. The scholarships consist of remission of tuition fees and the awards will be made on the result of the general entrance examination to the Polytechnic School of Engineering, to be held on September 12th, 13th, and 14th. All the courses provided in the Regent-street Polytechnic are recognised by the Institution of Mechanical Engineers, in the case of mechanical, structural and automobile engineering; by the Institution of Electrical Engineers, in the case of electrical engineering; and by the Board of Education, in connection with the award of National Diplomas. Moreover, the possession of such a diploma exempts the student from the technical portion of the examinations set by the Institution of Mechanical Engineers for the admission of associate membership. The National and School Diplomas are recognised by the Institutions of Electrical and Automobile Engineers.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

Awaiting Autumn Demand.

THIS week has witnessed no appreciable increase in iron and steel buyings, and manufacturers in the Midlands and Staffordshire have settled down to await the autumn demand, endeavouring in the interim to gauge the probable strength of the expected development of business. There are few who do not look for live improvement, though hopes appear to spring from expectation rather than anything concrete to be found on order books. A few pessimists draw dire inferences from the present indifference which is shown to forward contracting, but the optimists, though they admit the autumn demand is still a matter for conjecture, point out that in several directions there are ample grounds to anticipate a larger call for iron and steel materials. Important development schemes are in prospect concerning railways and factory building, and these should provide a very welcome fillip for some of the heavy industries. Constructional engineers are moderately well employed and report considerable new business in prospect. Rolling stock establishments will require much material for the carrying out of even the work at present on their books. The edge tool trade is consuming more material than for the past few months, while consumers of iron and steel, who are at present withholding orders, are doing so because they think there may be something to gain by abstaining, and that in the present relation of supply and demand they do not run any risk in deferring negotiations as to forward requirements till they can read more clearly the portents for the autumn trade. These orders will come on to the market before long, and though July and August have proved disappointing months, in the matter of turnover and in the amount of new business transacted September, it is considered, can be relied upon to initiate some reinvigoration of the heavy industries of this area.

Pig Iron Prices.

The weakness in pig iron values which I noted last week has increased, and though there has been no general change in quotations, values are lower by about 1s. 6d. per ton. Many smelters are still hoping that the advent of an autumn demand will reinvigorate trade, and avert further price depreciation. Recent production has, however, been in excess of absorptive capacity and smelters have stocks which are now beginning to cause them considerable anxiety. It appears they must either accept lower prices or blow out the furnaces. They hesitate to take the latter course, since they have outlasted the slack season so long and the expansion of demand usual in September is still in prospect. Any lowering of values, however, will, they maintain, entail considerable sacrifice unless output is greatly improved, and that is hardly to be expected for some weeks yet. Midland smelters affect indifference to the cuts which Cleveland blast-furnacemen have made, but consumers in this area press for similar concessions and the Birmingham market has been unable to prevent reaction. It is reported that both Derbyshire and Northamptonshire blast-furnacemen, to secure substantial orders, have lowered prices of foundry pig half-a-crown per ton, but it is pointed out that these are exceptional cases. Though some of the leading houses still quote the old rates, £3 7s. 6d. for Derbyshire No. 3 and £3 2s. 6d. for Northamptonshire No. 3, most of them were to-day prepared to do business at 1s. to 1s. 6d. less. North Staffordshire iron was offered at £3 5s. Forge prices do not appear so far to be materially affected. The course of events in this department provides the chief centre of interest. There is a certain amount of business about, but it is being suspended until smelters' settled policy is known. On the Birmingham market this week there was a rather better inquiry for hematite. East Coast mixed numbers made about £3 14s. at furnaces. The demand for basic pig is almost non-existent. Though two furnaces were blown out last month, leaving a total of 174 in operation out of a possible 442 in the British Isles, the small proportion in blast in the Midland area continued to operate, and it is hoped will continue to do so. Greatly improved business is looked for next month. Among the encouraging features of last month's trading was an increase in the export of foundry pig from 8423 tons, the June figure, to 15,205 tons. As a matter of fact we exported practically as much foundry pig as we imported. It is commented upon that, whereas forge and foundry qualities arrived in rather larger quantity, imports of basic pig were down over 5000 tons.

Steel.

Steel demand generally remains poor, purchases being rigidly confined to consumptive needs. Users are convinced that lower values are assured in the near future, and they are not disposed to buy any material which is not wanted for immediate use. Forward contracting is stated to be out of the question. It was reported this week that specifications for plates are coming in more freely against old contracts, but in other departments no forward movement is discernible. Steel masters in Birmingham this week adhered to recent quotations, naming £7 12s. 6d. for angles and joists, £8 12s. 6d. for tees, £8 7s. 6d. for ship, bridge and tank plates, and £11 to £11 10s. for boiler plates. Staffordshire hoops were quoted £10 10s. at works. There is a slightly improved call for small bars at £7 15s., but demand for billets at £6 10s. upwards is quiet. Offers of foreign steel are not so frequent, and English mills can supply any type of material specified. Heavy steel scrap is in sluggish demand at about £3 2s. 6d. delivered South Wales. Sales of foreign semi-finished steel have fallen away, although consignments have still to be delivered. Billets cost £5 5s. delivered, and iron or steel bars £5 16s. 6d It is noted by steel masters hereabouts that the most notable increase in imports last month under the head of manufactured material was in wire rods, bright steel bars, and kindred descriptions. Steel girders, beams, joists and pillars, the returns show, made a larger contribution to the total, and there were slight increases in half-products, wire, wire nails, and other wire manufactures.

Manufactured Iron.

The Staffordshire iron trade is still very quiet and no re-animation is looked for this month, which is a notably quiet one. At the moment there is not enough work to go round, although the marked bar houses have a reasonable amount of small orders. Railway contracts given out last month are providing employment at some of the works, and there are hopes that it will be reinforced in the near future by the considerable requirements of the Southern Railway's development schemes. Crown bars have been in rather better request. Values remain weak at £10 10s. upwards. Though chain, cable and anchor, and nut and bolt firms in the Darlaston area are a little better employed on home account, export business is poor. Last month saw a further drop in shipments of these goods, and it is hardly likely there will be any recovery this month. Nut and bolt and fencing iron continues to be quoted £9 15s. to £10, but continental material, on account of its much lower price, supplies the bulk of local makers' requirements. Midland tube works are moderately employed and there is a fair call for wrought iron gas tube strip, the price of which is maintained at £11 17s. 6d.

Sheet Values.

Galvanised sheets fully maintain the slight improvement noted last week; indeed they are slightly stronger, quotations on 'Change in Birmingham to-day—Thursday—ranging from £14 to £14 5s. for 24-gauge corrugated. While the larger firms are prepared to do business at the lower figure, district mills for small-scale business endeavour to obtain £14 5s. There is a moderate inquiry both on home and export account. It is gratifying to find that, in spite of the quieter conditions which have ruled in this department during the past six weeks, exports of sheets last month increased by 10,000 tons. It indicates, however, when production figures are considered, a poor home demand.

Trade Returns.

Some consolation is taken by industrialists in the Midlands from the knowledge that last month exports of iron and steel rallied again after the relapse in June, shipments amounting to 389,647 tons, against 366,647. They note with satisfaction that there was an increase of 18,000 tons in the railway material sent abroad and of 10,000 tons in galvanised sheets. It is unfortunate, however, that the gradual subsidence from the high import figures for January was arrested last month, shipments amounting to 336,261 tons, against 332,637 tons in June. The record of imports for the year up to date make even less pleasurable reading, showing, as they do, that foreign iron and steel imported in the first seven months of the current year totalled 2,906,532 tons, of the value of £22,298,366, as against 1,641,460 tons, value £13,548,883, in the corresponding period of 1926, and 1,609,140 tons, value £14,307,604 in 1925.

Workless.

The number of unemployed in the Midlands, as shown in the returns issued by the Ministry of Labour for the week ended August 15th, has decreased by 10,226. This is regarded as very satisfactory in view of the fact that the returns for the week ended August 8th showed a decrease of about 18,000 on those issued for the week before. The latest return shows that 143,279 are unemployed, and of that number 59,574 are working short time or are temporarily stood off work. The numbers now unemployed are as follows:—Men, 102,364; boys, 3903; women, 32,527; and girls, 4485. In the Birmingham area 25,795 are reported as being unemployed, as compared with 27,236 a week previous. In the Coventry area the number of unemployed continues to increase and now totals 8393, or roughly 2000 more than a fortnight ago. All the Black Country towns, with the exception of Walsall, where there is a slight increase, show decreases.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

Textile Machinery Exports.

If new overseas orders for textile machinery are not coming in in sufficient numbers to compensate makers for an inactive market at home, business already on the books is important enough to maintain shipments of this class of machinery at a fairly good level. Exports last month were somewhat above the average for this year, the total value being £959,379, compared with £885,633 in the corresponding period of 1926, spinning and twisting machinery accounting for £741,000 and weaving plant for £163,700. Substantially increased shipments to Russia made up for declines in other directions, notably to France and the Netherlands and "other European countries," compared with June. The British East Indies provided the largest individual market with £191,064, followed by Russia with £152,333 (the June exports to that market were down to £11,830), Germany with £79,886, the Netherlands with £70,915, South America with £53,797, Japan with £48,652, France with £42,195, the United States with £41,414, Australia with £23,114, China with £19,021, and "other countries in Europe" with £199,503, compared with £229,981 in the preceding month. Although last month's exports were of a higher aggregate value than in June, the quantity was lower at 9152 tons, against 9413 tons in the previous month.

The War on Smoke.

The Manchester and District Regional Smoke Committee, which was formed two years ago and covers an area within a radius of 15 miles from the centre of the city, comprising some 104 local authorities, is, according

to a statement by its chairman, Alderman W. T. Jackson, considering the framing of by-laws which will confer powers on local authorities through their building committees to disapprove of plans for new buildings, such as hotels, warehouses, restaurants and offices, unless certain provision is made for the prevention of smoke in their heating arrangements. The regulations, Mr. Jackson hints, may conceivably prohibit the burning of raw coal at all, the alternatives being electricity, gas, or smokeless fuel.

Tramcars Not Moribund.

Alderman Bowes, the chairman of the Manchester Tramways Committee, is emphatic in his opinion that the day of the tramcar is by no means nearing its end. Speaking this week in connection with the annual inspection of the city's tramway undertakings, he said that the tramcar had been declared some years ago to be a moribund and obsolete form of transport. The fact remained, however, that some 26 miles of new tramways had to be added to the Manchester system during the last four years, and a new route 3 miles long was under construction between Middleton and Heywood. Last year the Committee had to purchase fifty more cars of the bogie saloon type, and in its own works were now converting single-truck cars into that type at the rate of about twenty-five a year. As evidence of the usefulness of the Manchester system, Mr. Bowes said that the Manchester tramway vehicles ran nearly 23,000,000 miles a year and carried considerably more than 300,000,000 passengers, or nearly 1,000,000 per working day.

Non-ferrous Metals.

Whilst copper, lead and spelter, after a steady fall in the previous three weeks, had about held their own, tin has suffered a further serious decline and values are now back to where they were a month ago, prior to the sudden spurt at the end of July and during the opening days of the present month. A continued quiet demand for industrial consuming interests in this country has been accompanied by a falling off in the demand from American users and reduced support from the speculative element. The result has been a decline in prompt metal, equal, at the time of writing, to nearly £4 10s. per ton, although the three months' position has been less seriously affected. In spite of a very moderate demand for copper from users, a rather more hopeful view is being taken respecting the outlook for the metal, and most of the loss which this section of the non-ferrous metals market sustained in the early part of the period under review has since been recovered, and on balance values are only fractionally below what they were a week ago. Similar conditions have operated in the case of spelter. Inquiry has been on a restricted scale, but the loss on the work has been almost insignificant. Lead has finished up quite steady and unchanged on balance, in spite of a relatively poor demand.

Iron.

Last week's "cut" in Middlesbrough iron has not been without its influence on other varieties offered on the Lancashire market. Notwithstanding the complaints of makers that recent selling prices were already below production costs and the indisputable fact that for several weeks quotations have been at, if not below, the pre-strike levels, Derbyshire brands of No. 3 foundry iron are now selling at 6d. to 1s. per ton lower than they were a week ago, the f.o.r. furnace basis now being 66s. 6d., which is equal to about 74s. 6d. per ton delivered in the Manchester district. Staffordshire makers have offered more resistance and are quoting for delivery here 75s., with Scottish pig iron quoted at 92s. 6d. to 93s., and hematite at about 89s. Middlesbrough brands stand at the revised price for delivery in Lancashire of 80s. 8d. per ton. Up to the present the reduction of 2s. 6d. in the last-named has not attracted any more business. As a matter of fact, the demand for pig iron in all sections of the market continues on very moderate lines. The state of trade in the case of finished iron can readily be gauged from the fact that Lancashire makers of bars have this week reduced the prices for Crown and second qualities by 20s. and 10s. per ton respectively, making current values of these £10 and £9 10s. Even so they are not too sanguine about booking much more business than has come their way during the past few months, when, in most instances orders have not been sufficient to justify running plant at more than half capacity.

Steel.

The steel market this week has been mildly excited over the rebate scheme which British steel makers are said to be putting into operation early next month. Up to the present not much has been allowed to escape regarding the details of the scheme, although it is understood that rebates based on quantities ordered and an undertaking by users to refrain from purchasing or to limit their purchases of foreign material are essential features. As it is expected that more information will be available with the next few days, little or no business is being done for the time being, with prices nominally unchanged from what they were a week ago. Galvanised sheets are still being quoted at about £14 per ton f.o.b. for the usual Bombay or Calcutta specifications, but there is only a limited export demand at the present time. With regard to thin sheets values are maintained, but with heavy stocks held in most of the eastern markets few new orders are coming through. Rather more business has been passing in imported steel, more particularly in the semi-finished products, and with the single exception of wire rods, which have eased off again slightly, values are steady in pretty well every section. Joists and sections, for delivery to Lancashire works for cash against shipping documents, are quoted at about £5 15s., with ordinary plates at £7 5s., Siemens plates at £7 10s., steel bars at £5 15s. to £5 17s. 6d., billets at £5 2s. 6d. to £5 3s. 6d., sheet bars at £5 6s. to £5 7s., and wire rods at about £6 11s. per ton.

Scrap.

The demand for non-ferrous metal scrap on this market has been quiet and in most cases prices are easy, lead being quoted at £23, brass rod turnings at £30, heavy yellow brass at £44, zinc at £23, cast aluminium at £72, clean light copper at £56, and selected gun-metal at £52 per ton, for graded qualities and including delivery to buyers' works.

BARROW-IN-FURNESS.

Hematite.

The state of the pig iron trade in the West Coast district remains about the same, and customers are still confining their orders to immediate requirements. At the same time, there are a few signs which suggest an improvement, in view of the fact that the steel works at Barrow are likely to continue for some time. A considerable amount of the iron output will go in that direction. There is a tendency on the part of some to expect slight improvement within the next month, for it is admitted that buyers, considering the orders that they have in hand, cannot continue to buy only enough material to meet their requirements in the immediate future, and that there may be a return on their part to placing orders for forward delivery. Much of this development will depend upon the price of iron. Customers are hoping for further reductions, and that is believed to be one of the reasons why they are holding off from placing substantial orders, with deliveries split up over a period.

Iron Ore.

The iron ore trade is a reflection of the iron trade, and until there is an increase in the number of furnaces in the district trade will continue as it is at present.

Steel.

In the steel trade there is a little more hope. A few months ago Barrow steel works only had contracts to take them up to the holidays, but the subsequent receipt of orders now guarantees practically an uninterrupted run through the next two months. In the meantime it is hoped that further orders will come to hand.

SHEFFIELD.

(From our own Correspondent.)

Steel Trade Position.

It is unlikely that there will be any material change in the state of the local iron and steel trades for some weeks. There are hopes that the approach of autumn will find buyers in a more serious mood and prepared to discuss substantial business. At present they are not doing so. They are buying in very small lots, and there is much uncertainty as to the future. Work is irregular and a brief rush period is followed by a quiet spell which finds men back on the suspended list. Many bitter complaints are heard among steel manufacturers as to the effect which foreign competition is having on their business, and the position is certainly worse to-day than it has ever been. The output of open-hearth steel is considerably less than it was early in the year, being back to the position of meeting, what are to all intents and purposes, day-to-day orders. Few big contracts are being booked, and users are carrying very little in the way of stocks. However, in spite of the many difficulties with which they are faced, the steel makers are managing to maintain production. Makers of special steels are having a somewhat better time. Some of them report good order books, and specialised products are well holding their markets. Current business in raw materials does not give much hope for encouragement. In spite of the recent reductions business does not develop materially, and buyers will not place important contracts. Orders are being confined to quantities just large enough to cover immediate requirements. This sort of thing has been going on now for a long time, but next month may see buyers forced to adopt a different policy and look further ahead in regard to their business.

Engineering Departments.

The engineering industry is distinctly short of work, and there is a good deal of plant standing idle. It is the heavy branches that are suffering most, but some headway is being made in the greater specialisation of smaller castings and forgings, and firms which have kept pace with the times are finding a fair amount of work coming through. The foundries and mills producing semi-finished material may be roughly calculated on the average to be working up to about two-thirds of their capacity, but they have to handle a good deal of comparatively small stuff on which they cannot make much, if any, profit. Sheffield and the immediate district has a good share of the most modern foundries and mills in the country, and their output capacity is so enormous that they can fairly eat up the work. Orders on a scale to keep up the continuous working which was in mind when these plants were laid down are rare in these days unfortunately, and managers have an anxious time to fit in their work to the best advantage. There is a moderate amount of railway work in hand, but quotations have to be very keen to get business. Negotiations in oversea markets are difficult in face of severe foreign competition.

Spanish Steel Tariffs.

The Spanish Commission to revise the Spanish tariffs is to sit on October 1st and considerable interest in the proceedings is being taken by the Sheffield firms concerned. A great amount of dissatisfaction has been expressed locally in regard to the classification of certain steels, and there is evidence that owing to wrong classification a considerable amount of trade has been lost to the district. The Sheffield Chamber of Commerce, in anticipation of the revision, has already drawn up a preliminary document stating Sheffield's case. This has been submitted to the proper authorities, and the whole situation is being very carefully watched.

The Lighter Trades.

There is no change to report in the tool, silver, plate and cutlery trades. As for some time past, conditions have been variable in the tool trades. The loss of the Russian market—one hopes for the time being only—has meant a big difference to the makers of saws, files and rasps, and some of the Far Eastern markets have also been buying on a reduced scale of late. Small tools for engineering work are being less freely bought, but the heavier classes of tools are certainly maintaining, and in some cases increasing, their output and exports. In this category may be included spades and shovels, road, quarry and mining tools. The output of the cutlery works is considerable in the aggregate, particularly in stainless knives, forks and spoons, but it is much less than it could be, and in consequence there is much competition for the business on offer. Sheffield works are carrying out a number of important contracts for big catering establishments. The July returns show that the export trade in that month was not maintained on account of smaller shipments to Australasia. In spite of a big increase in the sales abroad of safety razors and blades the shipments of cutlery this year are £30,000 down on the figures for last year and £60,000 below those for 1925.

Engine Building Programme.

Although at present no official information is forthcoming, it is understood from a reliable source that the London and North-Eastern Railway Company proposes to build ten "Pacific" engines at the Doncaster Works, and it is not improbable that other orders will follow. There are fifty-two "Pacific" engines already running on the company's system, and thirty-two of them were built at Doncaster. Certain alterations were carried out on "Pacific" engines recently at the works, when they were fitted with altered valve gear to effect economies in the consumption of fuel and water. The experiment has been successful, and it is very probable that the new engines will be similarly equipped. At the moment the Doncaster works are fairly busy.

Interesting Coal Discovery.

The famous Low Moor Blackbed seam in the Bradford district, which was lost through faults in the local strata, has been regained at the Toftshaw Moor Pit, Tong, owned by the Cleckheaton Colliery Company. The coal uncovered is in such a quantity and of such a quality that it is hoped that the discovery will do something to re-establish Low Moor as a coal mining centre. Some twenty years ago there was a flourishing mining industry carried on in the district, but it gradually waned, and when the Bowling Ironworks and their pits closed down about thirteen years ago, the only mine being carried on was the Toftshaw Moor Pit, and it is at this pit that the seam has been rediscovered. It was calculated that the broken seam continued in a line which passed within 45 yards of a working in the Toftshaw Pit. For some weeks men have been engaged in driving a tunnel, and the seam was uncovered at the point estimated. The seam is 28in. thick, and consists of best quality steam and gas coal. It is about 120 yards from the surface, and there is a strata of ironstone above it, though this has not yet been proved. According to the secretary of the Cleckheaton Colliery Company, the seam will be workable for fifteen or twenty years, and will provide continuous employment for many more men than are engaged at present. Work on the new seam will be started shortly. Last week I referred to the excellent progress that has been made in the sinking of the new Bilsthorpe Colliery of The Stanton Ironworks Company, Ltd., and, as then anticipated, coal has now been reached in the top hard seam. The annual report of the new Monckton Collieries, Ltd., near Barnsley, records that operations at No. 5 shaft are again proceeding, and it is expected to complete this work during the coming year. The second 1500-kilowatt generator has been installed and is working most satisfactorily with good economic results.

A New University.

It is announced that the Ministry of Health has sanctioned the expenditure by Hull Corporation of £150,000 towards the erection of buildings required for a University at Hull. It will be built from a nucleus fund of £250,000 given by the Rt. Hon. T. R. Ferens, Lord High Steward of Hull. Work on the foundations commenced this week.

NORTH OF ENGLAND.

(From our own Correspondent.)

Steel Trade Rebate Scheme.

Considerable interest has been aroused in steel trade circles in the North of England this week as the result of a scheme, which is now under consideration by the steel manufacturers, for giving a substantial rebate to each customer who, over a defined period, limits his purchases of steel to the British market. The object, of course, is to counteract foreign competition and also to capture the increasing trade which is going from this country to continental consumers. This move, following closely upon the reductions in the selling price of pig iron made last week, gives emphasis to the belief that the British iron and steel trade has tolerated long enough the wholesale invasion of the home market by foreign manufacturers. Although a definite decision has not yet been reached, it is understood that the Cleveland steel makers generally favour the scheme. Cleveland has been badly hit by foreign competition, and for some time past iron and steel cargoes have been arriving in the district from the Continent at six or seven times the pre-war rate.

Cleveland Iron Trade.

The apathy which has characterised the Cleveland iron market for so long appears to be fading with the passing of the holiday season, and the general tone is

better now than it has been for some months past. The all-round reduction made in prices last week has resulted in much livelier markets, and sales of iron in the past five or six days are reported to have been the heaviest for any similar period this year, although local orders form a large proportion of the volume. Business with Scotland—usually one of Cleveland's best customers—has not yet responded to the stimulus, but this may be explained by the fact that many Scottish consumers still have large quantities of continental pig iron to take under contracts made some time ago. The fall lowers quotations to a level that promises virtually to shut out continental competition for the trade of this district, and ironmasters consider that there is now a prospect of recapturing to some extent the trade with consumers in other areas. Merchants complain that the new conditions of sale will hamper export trade. The reductions of 2s. 6d. for home consumption are acceptable, but the stipulation that similar prices must be paid for export parcels of under 500 tons, whereas for quantities above 500 tons a further price concession of 2s. 6d. is made, is meeting with much disapproval, exporters declaring that foreign customers will expect to place orders for small lots at the 5s. reduction. For home use No. 1 Cleveland foundry iron is 70s.; No. 3 G.M.B., 67s. 6d.; No. 4 foundry, 66s. 6d.; No. 4 forge, 66s. Everything now depends upon whether continental firms will be able to retaliate by again lowering their prices. The prevailing opinion in Cleveland is that foreign makers are already dumping iron at a loss, and that they will hesitate to reduce quotations further.

Hematite Pig Iron.

Rather better accounts are given of the East Coast hematite pig iron trade, but there is still vast room for improvement. Output has shrunk to an extent that inspires hope of steady withdrawals from makers' rather heavy stocks to meet the slight expansion in demand. A few inquiries from the Sheffield district are circulating, and continental consumers are reported to be paying a little more attention to this market. Values are upheld. Consequently the normal difference in price between mixed numbers and No. 3 Cleveland has been restored. Mixed numbers are quoted at 75s. 6d. and No. 1 quality at 76s.

Ironmaking Materials.

Consumers of foreign ore have such heavy supplies that not only are they keeping off the market, but they are endeavouring to delay acceptance of cargoes due for delivery under old contracts. Nominally, market rates remain on the basis of best Rubio at 21s. c.i.f. Tees. Producers of Durham blast-furnace coke are very reluctant to lower their already unremunerative quotations, but ironmasters are buying very sparingly, as they confidently anticipate price concessions in the near future. Good average qualities are quoted at 19s. per ton delivered at the works.

Manufactured Iron and Steel.

The total tonnage output in the manufactured iron and steel trade keeps heavy, and in some branches manufacturers have still work to execute that will keep them employed for several weeks, but in other departments contracts are fast approaching completion, and new orders are difficult to secure. Pending some definite decision regarding the scheme now being considered by the steel makers to combat continental competition by offering a system of rebates to consumers who adhere to British purchases, business will remain on the quiet side.

Shipbuilding.

Welcome additions to the orders on Wear shipbuilders' books have come through the booking by Robert Thompson and Sons, Ltd., Southwick, of two cargo vessels for the Claymore Shipping Company, Ltd., of Cardiff. These new orders supplement those already reported and have appreciably improved the Wear's shipbuilding outlook, which at the beginning of the year was far from favourable.

The Coal Trade.

The dull period of the year in the coal trade is drawing to its close, and it is generally believed that more activity is at hand. September will, it is hoped, make a difference. Collieries are working fairly well on prompt orders, but the general volume of trade remains poor. The uneconomic state of the coal industry continues to be a matter of serious concern. It is understood that the Durham coalowners will meet next month to consider the position, and Northumberland owners will probably meet before long for a similar purpose. The collieries are confronted with a perplexing problem, as costs, of which wages constitute the chief part, are so much greater than the money derived from the sale of the coal. There are now stronger hopes that with the autumn, if not before, there will be a fuller demand, and that this will affect prices. There seems to be a fair amount of forward inquiry, but neither sellers nor buyers are very keen to negotiate, especially on current terms. Sellers, on their part, are trying to improve on present figures for supplies ahead. Consumers do not appear to have pressing needs and buy sparingly, so that holders of any prompt coal are finding it difficult to clear and are not averse to shading quotations a little for definite business. This is a weak feature of the market. Best Northumberland steams are quoted from 14s. 3d. to 14s. 6d. for next month and later, but are discountable for prompt shipments. The gas coal position is rapidly improving in tone, and recent prices are firmly maintained. Best Durham qualities command 16s. to 16s. 6d., and secondary 14s. to 14s. 6d. Coking coals for export are in good demand, but home requirements are moderate, and this prevents any appreciation in prices setting in. For good grades 13s. 6d. to 14s. is quoted. Bunker coals show an improving tendency. Coke shipments are of considerable volume, but the home demand is slow. Gas coke stocks are low and makers quote firmly, but for spot shipment second-hand holders offer moderate size parcels at 20s. 3d., while for forward 20s. 9d. to 21s. is indicated. Patent foundry coke is quiet, good ordinary makes being plentiful at 17s. 6d. to 18s. 6d.

SCOTLAND.

(From our own Correspondent.)

Foundry Workers' Wages.

A CLAIM has been made on behalf of the employers connected with the National Light Castings Industry Association for a reduction of 12½ per cent. in the rates of all workers engaged in the manufacture of baths. It is stated that in view of foreign competition home manufacturers are obliged to secure this reduction in the cost of production to enable them to compete against German and French products. The German article is said to be from 8s. to 11s. cheaper than the British bath, and the reduction claimed would represent a saving of 2s. 6d. in the cost per bath. A large number of workers in Bonnybridge and Falkirk districts would be affected, as the foundries in these districts are mainly engaged in the production of bath and other fittings for housing schemes.

Electric Locomotive for the London, Midland and Scottish Railway.

Reports state that a complete and improved oil-electric generator set of 500 horse-power is under construction by Wm. Beardmore and Co., Ltd., Glasgow, for the London, Midland and Scottish Railway. It is intended to install this engine in a four-coach train which will undergo extensive trials.

Steel.

No particular change is reported in the steel trade. Makers are fairly well occupied with old contracts, and moderate deliveries of ship plates and sections are being made to the shipyards. New business is still slow, however. Prices remain at the official minimum.

Steel Sheets.

Black sheets of the heavier gauges are in very quiet demand. Galvanised sheets, on the other hand, are well booked, the lower level of prices having attracted a considerable amount of business, and orders continue to come in. Best quality galvanised and black sheets have healthy inquiries, and the outlook is promising.

Iron.

Bar iron is very slow, and while the home price is unchanged the export quotation could be shaded for a good specification. Re-rolled steel bars have been reduced by 5s. per ton, the new price being £7 17s. 6d. per ton for home delivery, and about £7 10s. per ton for export.

Pig Iron.

The action of the Middlesbrough producers in reducing their prices to continental levels has provided the feature of interest in the local market. It is hoped that the home industry here and across the Border may benefit thereby. Prices of Scotch pig iron still depreciate, but it has been stated that any further drop may necessitate the reduction of the number of furnaces in blast. Therefore while the prices now current have induced a certain amount of business, further reductions are not deemed likely despite ample stocks. The number of furnaces in blast at present is thirty-six.

Imports and Exports.

Recent arrivals of iron ore have been light, amounting to only some 5800 tons. Semi-finished iron products have arrived in larger bulk from the Continent. Shipments of manufactured iron products amounted to about 4000 tons.

Coal.

The export inquiry for Scottish coal has improved somewhat during the past week, and while actual business is slow to accrue the outlook is better. Lanarkshire splints maintain a firm attitude with comparatively good bookings. Ell coals, on the other hand, are inactive and weak, with steams little better. Fifeshire and Lothian steams are more active, the former partly on account of Swedish contracts. Consequently washed materials in these districts are more plentiful, and somewhat easier in price. Shipments show considerable improvement, the aggregate returns amounting to 279,321 tons, compared with 246,124 tons in the preceding week and 210,524 tons in the same week in 1925.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade Conditions.

IT cannot be said that the conditions in the steam coal trade are appreciably better for early loading. At the end of last week there were no less than forty-three vacant loading berths at the various docks in this district, and on Monday the position was not much improved, inasmuch as the number of idle berths was only reduced to thirty-four. It was thought that arrivals of tonnage over the week-end would have been greater, but as a matter of fact very bad weather prevented the movement of tonnage, and this has been disappointing to many collieries, whose difficulties in securing empty wagons have been aggravated. Shipments last week were certainly more encouraging, as the total came to 379,500 tons, as against 297,400 tons, which was an exceedingly low figure. There are hopes that this improvement will continue, although the inquiry is still on very moderate lines for prompt loading and tonnage available for employment is none too plentiful. It is interesting to note that the Italian Navy has purchased recently 34,000 tons of Welsh steam coal and the Dutch and Norwegian Navies are seeking prices for small quantities. In the case of home inquiries the Bristol Electricity Works are in the market for 50,000 tons of washed duffs, and the Plymouth Electric Supply Co. requires offers for 18,000 tons of beans and peas over the next twelve months. Business which invariably creates a good deal of interest on the market is that of the Egyptian State Railways. They recently asked for tenders for 125,000 metric tons of large coals and the prices had to be at Cairo on the 23rd for adjudication. The prices have to hold good for ten days from that date. The period of shipment is September, October and November. The prices which have been put in for this business have caused more than ordinary comment, as the lowest is that of Watts, Watts and Co. at 28s. 2d. per ton c.i.f. Alexandria, other quotations being 28s. 7d., 28s. 10½d., and 29s. 3d. It is fully expected that Watts, Watts and Co. will get the order. Their figure of 28s. 2d. is considered a very low one, but, of course, they have the advantage of having behind them a fleet of steamers, whereas most of the other firms tendering have to take the risk of securing their tonnage on the open market. It is interesting to note that in May last Furness, Withy and Co. took the order of the Egyptian State Railways at 32s. 3d., while in March, Tabb and Burlitson, Ltd., contracted for the business at 33s. 5d. per ton, and in January J. Rolo and Co., of Alexandria, with whom were associated Instone and Co., of Cardiff, took the order at 31s. 11d. per ton.

Spanish Government Decree.

Reference was made last week to the new Spanish Government decree which has been issued for the benefit of Asturian coalowners and is designed to limit the importation of foreign coals. From the news which has since come to hand it looks very much as if the Spanish Government is making known the extent of its regulations piecemeal, as another decree has been issued which affects bunkering trading from floating coal-hulks. It is understood that the Spanish Government will only permit floating hulks provided they are of Spanish ownership, and they must arrange for a proportion of the coal supplied to be Spanish coal and equivalent to the value of the British coal shipped. This new regulation applies not only to hulks at Spanish ports, but to the hulks at the Canary Islands. The matter is a very serious one, as the bunkering business at Spanish ports and at the Canary Islands has been built up almost entirely by British capital, and it goes without saying that by far the greatest percentage of the coal used has been drawn from South Wales, so that this district stands to suffer most. As a matter of fact over 300,000 tons of British coals were shipped during the first seven months of this year to the Canary Islands, and of this quantity over 60 per cent. was taken from South Wales. The matter has, of course, been taken up by the interested parties, and the British Coal Exporters' Federation has called the attention of the Board of Trade to this new development. The Spanish Government will find, however, that it cannot without loss make such stringent regulations, as this is a matter in which shipowners generally will have a voice.

Tin-plate Trade.

The conditions in the tin-plate industry of this district continue to be very unsatisfactory and one or two works have had to close down. The question of the irregular employment in the trade was the subject of discussion at a meeting of the workmen's side of the Tin-plate Joint Industrial Council held at Swansea on Monday. Various proposals were put forward for alleviating the troubles in the trade, and eventually it was decided to ballot the workers on the question of working hours, it being suggested that shifts should be reduced from eight to six during the period of depression, so as to permit of a more equitable distribution of work.

Ship Repairing Industry.

Mention has been made on several occasions of the depression which has prevailed for some time in the ship repairing industry. Of course, all the firms in this line had a very bad time last year owing to the operation of the national coal strike. During that period it is estimated that the industry was rarely engaged at more than 30 per cent. of its normal capacity. Substantial losses were made by all undertakings, and this year the conditions have been far from satisfactory. The result is that one firm—Hills Dry Docks and Engineering Company, Ltd., of Cardiff—decided recently to close down its works for the time being. Since 1922 this company has suffered losses amounting to more than £50,000.

Miners' Application.

At a meeting of the Subsistence Wage Joint Sub-Committee of the South Wales Coal Board on Tuesday, the chairman of the owners' side stated, with regard to the workmen's application for an increase in rates to a number of grades, that the application was not consistent with the terms of the agreement. A very heavy burden had been put on the owners by the subsistence wage award and the application, if conceded, would mean an increase in that burden and would not remove the anomalies which the award had created. The owners were not reluctant to pay higher wages, but were prevented from so doing by the inability of the industry to pay. The proposals therefore could not be entertained.

Cyfarthfa Ironworks Site.

The old Cyfarthfa Ironworks site at Merthyr has been sold by the Wingfield and Mackintosh Estate to two Merthyr townsmen, Messrs. W. Bertram Harris and F. S. Simons, and it is expected that in the next few months developments will take place which will provide employment for between 1000 and 1500 men. A commencement has been made by the erection of cold storage plant. The property embraces 55 acres of freehold land.

Current Business.

Business has not come along in any increased volume for prompt loading, and it is not surprising that quotations for practically all descriptions have not moved as compared with a week ago. Further collieries have closed down pits or given the necessary notices to terminate the employment of workmen. The market for large coals continues to rule on the easy side for immediate shipment. The only market which displays any steadiness is that for smalls and washed coals. These qualities are rather scarce and firm, but there is no improvement in coke or patent fuel.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. Coast—	
Native	18/6 to 21/-
(1) Spanish	18/6 to 21/-
(1) N. African	18/6 to 21/-
N.E. Coast—	
Native	18/- to 21/-
Foreign (c.i.f.)	21/-

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) Scotland—		
Hematite	3 18 6	—
No. 1 Foundry	4 1 0	—
No. 3 Foundry	3 16 0	—
N.E. Coast—		
Hematite Mixed Nos.	3 15 6	3 15 6
No. 1	3 16 0	3 16 0
Cleveland—		
No. 1	3 10 0	(d) 3 7 6
Silicious Iron	3 10 0	,, 3 7 6
No. 3 G.M.B.	3 7 6	,, 3 5 0
No. 4 Foundry	3 6 6	,, 3 4 0
No. 4 Forge	3 6 0	,, 3 3 6
Mottled	3 5 6	,, 3 3 0
White	3 5 6	,, 3 3 0
Midlands—		
(3) Staffs.—		
All-mine (Cold Blast)	—	—
North Staffs. Forge	—	—
,, ,, Foundry	3 5 0 to 3 6 0	
(3) Northampton—		
Foundry No. 3	3 1 0 to 3 2 6	
Forge	2 17 0	—
(3) Derbyshire—		
No. 3 Foundry	3 6 0 to 3 7 6	
Forge	3 5 6	—
(3) Lincolnshire—		
No. 3 Foundry	3 5 0	—
No. 4 Forge	3 5 0	—
Basic	3 7 6	—
(4) N.W. Coast—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	4 8 6 (a) / 4 11 6 (b) / 4 15 6 (c)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
Scotland—		
Crown Bars	10 15 0	10 10 0
Best	—	
N.E. Coast—		
Iron Rivets	12 5 0	—
Common Bars	11 5 0	—
Best Bars	12 5 0	—
Lancs.—		
Crown Bars	10 0 0	—
Second Quality Bars	9 10 0	—
Hoops	14 0 0	—
S. Yorks.—		
Crown Bars	11 10 0	—
Best Bars	12 5 0	—
Hoops	14 0 0	—
Midlands—		
Crown Bars	10 10 0 to 10 15 0	
Marked Bars (Staffs.)	13 10 0	—
Nut and Bolt Bars	9 15 0 to 10 0 0	
Gas Tube Strip	11 17 6 to 12 0 0	

STEEL.

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) Scotland—		
Boiler Plates	11 0 0	11 0 0
Ship Plates, ½in. and up	8 2 6	7 12 6
Sections	7 12 6 to 7 15 0	7 2 6
Steel Sheets, under 3/16in. to ¼in.	10 5 0 to 11 5 0	
Sheets (Gal. Cor. 24 B.G.)	— £14 5 0 to 15 5 0	

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. Coast—		
Ship Plates	8 2 6	—
Angles	7 12 6	—
Boiler Plates	12 10 0	—
Joists	7 12 6	—
Heavy Rails	8 10 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5
Hard Billets	8 12 6	—
Soft Billets	7 12 6	—
N.W. Coast—		
Barrow—		
Heavy Rails	8 5 0	—
Light Rails	8 10 0 to 8 15 0	
Billets	7 10 0 to 10 0 0	
Manchester—		
Bars (Round)	8 12 6	—
,, (Small Round)	7 17 6	—
Hoops (Baling)	11 0 0	11 0 0
,, (Soft Steel)	10 0 0	10 0 0
Plates	8 7 6	—
,, (Lancs. Boiler)	11 5 0	—
Sheffield—		
Siemens Acid Billets	10 0 0	—
Hard Basic	8 2 6 to 8 12 6	
Intermediate Basic	7 12 6	—
Soft Basic	7 0 0	—
Hoops	11 10 0	—
Soft Wire Rods	9 5 0	—
Midlands—		
Small Rolled Bars	7 15 0 to 8 0 0	
Billets and Sheet Bars	6 10 0 to 6 15 0	
Sheets (20 W.G.)	11 10 0 to 12 0 0	
Galv. Sheets, f.o.b. L'pool	14 0 0 to 14 5 0	
Angles	7 12 6	—
Joists	7 12 6	—
Tees	8 12 6	—
Bridge and Tank Plates	8 7 6	—
Boiler Plates	11 0 0 to 11 10 0	

NON-FERROUS METALS.

Swansea—	
Tin-plates, I.C., 20 by 14	18/4½ to 18/7½
Block Tin (cash)	289 2 6
,, (three months)	284 2 6
Copper (cash)	55 0 0
,, (three months)	55 7 6
Spanish Lead (cash)	22 15 0
,, (three months)	23 2 6
Spelter (cash)	27 15 0
,, (three months)	27 15 0
Manchester—	
Copper, Best Selected Ingots	61 10 0
,, Electrolytic	62 10 0
,, Strong Sheets	86 0 0
,, Tubes (Basis Price) lb.	0 1 0½
Brass Tubes (Basis Price), lb.	0 0 11½
,, Condenser, lb.	0 1 1½
Lead, English	24 7 6
,, Foreign	23 2 6
Spelter	28 0 0
Aluminium (per ton)	£107

FERRO ALLOYS.

(All prices now nominal.)

	Per Ton.	Per Unit.
Tungsten Metal Powder	1/8½ per lb.	
Ferro Tungsten	1/3½ per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£23 10 0	7/6
,, ,, 6 p.c. to 8 p.c. ,,	£22 15 0	7/3
,, ,, 8 p.c. to 10 p.c. ,,	£22 7 6	6/6
,, ,, Specially Refined		
,, Max. 2 p.c. carbon	£36 5 0	11/6
,, ,, ,, 1 p.c. ,,	£42 5 0	15/-
,, ,, ,, 0·70 p.c. carbon	£54 0 0	17/6
,, ,, ,, carbon free	1/4 per lb.	
Metallic Chromium	3/- per lb.	
Ferro Manganese (per ton)	£12 10 0	for home, £16 for export
,, Silicon, 45 p.c. to 50 p.c.	£12 12 6 per unit	scale 5/- per
,, ,, 75 p.c.	£19 5 0 per unit	scale 6/- per
,, Vanadium	14/3 per lb.	
,, Molybdenum	5/- per lb.	
,, Titanium (carbon free)	0/11½ per lb.	
Nickel (per ton)	£170	
Ferro-Cobalt	9/3 per lb.	

FUELS.

SCOTLAND.

(Prices not stable.)

	Export.
Lanarkshire—	
(f.o.b. Glasgow)—Steam	13/6
,, ,, Ell	13/6
,, ,, Splint	15/6 to 17/6
,, ,, Trebles	15/-
,, ,, Doubles	14/-
,, ,, Singles	13/- to 13/3
Ayrshire—	
(f.o.b. Ports)—Steam	13/6
,, ,, Jewel	15/6
,, ,, Trebles	15/- to 15/6
Fifeshire—	
(f.o.b. Methil or Burntisland)—Steam	11/9 to 14/-
Screened Navigation	18/- to 19/-
Trebles	15/6 to 15/9
Doubles	14/- to 14/3
Singles	13/3
Lothians—	
(f.o.b. Leith)—Best Steam	13/-
Secondary Steam	12/3
Trebles	16/-
Doubles	15/-
Singles	13/6

ENGLAND.

	Inland.	Export.
(8) N.W. Coast—		
Steams		22/6
Household		42/6 to 58/6
Coke		23/6
Northumberland—		
Best Steams		14/6
Second Steams		13/3 to 13/6
Steam Smalls		10/6
Unscreened		13/- to 13/6
Household		21/- to 27/-
Durham—		
Best Gas		16/- to 16/3
Second		13/9 to 14/3
Household		21/- to 27/-
Foundry Coke		19/- to 26/-
Sheffield—		
Best Hand-picked Branch	27/6 to 28/6	—
Best Selected House Coal	21/- to 22/6	—
Screened House Coal	19/- to 21/-	—
,, ,, Nuts	16/- to 17/6	—
Yorkshire Hards	16/- to 17/-	—
Derbyshire Hards	16/- to 17/-	—
Rough Slacks	9/6 to 10/6	—
Nutty Slacks	7/6 to 8/6	—
Smalls	3/- to 5/6	—
Blast-furnace Coke (Inland)	21/- to 22/-*	—
,, ,, (Export) f.o.b.		20/- to 21/-

(9) SOUTH WALES.

Cardiff—	
Steam Coals:	
Best Smokeless Large	20/- to 20/6
Second Smokeless Large	19/- to 19/6
Best Dry Large	19/- to 19/6
Ordinary Dry Large	18/- to 18/6
Best Black Vein Large	18/- to 19/-
Western Valley Large	18/- to 18/6
Best Eastern Valley Large	17/6 to 18/-
Ordinary Eastern Valley Large	17/- to 17/6
Best Steam Smalls	13/6 to 14/3
Ordinary Smalls	12/- to 13/-
Washed Nuts	18/- to 21/6
No. 3 Rhondda Large	20/- to 20/6
,, ,, Smalls	16/- to 16/6
No. 2 ,, Large	17/- to 17/6
,, ,, Through	16/- to 16/6
,, ,, Smalls	13/- to 14/-
Foundry Coke (export)	35/- to 40/-
Furnace Coke (export)	27/6 to 30/-
Patent Fuel	23/6 to 24/6
Pitwood (ex ship)	33/6 to 34/6
Swansea—	
Anthracite Coals:	
Best Big Vein Large	37/- to 40/-
Seconds	28/- to 32/6
Red Vein	25/- to 30/-
Machine-made Cobbles	42/6 to 45/-
Nuts	42/6 to 47/-
Beans	30/- to 32/6
Peas	18/6 to 20/6
Breaker Duff	8/- to 8/6
Rubbly Culm	9/- to 9/6
Steam Coals:	
Large	18/6 to 19/6
Seconds	17/6 to 18/-
Smalls	10/6 to 12/-
Cargo Through	15/6 to 16/-

(1) Delivered. (2) Net Makers' works. (3) f.o.t. Makers' works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire.

(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/- extra delivered England. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. (a) Delivered Glasgow.

(b) Delivered Sheffield. (c) Delivered Birmingham. (d) For orders of 500 tons or more, Prices also apply to Scotland. * Official quotation for pig iron producers.

French Engineering Notes.

(From our Correspondent in Paris.)

The Franco-German Treaty.

THE signing of the commercial treaty between France and Germany seems likely to mark a turning point in the future trade relations of France with other countries. So far, the policy of France has been to render herself as far as possible self-supporting in order to be independent of foreign products in times of emergency, and as the creation of new manufacturing industries has been encouraged, it was hoped to develop them by offering manufacturers a sufficient measure of protection from foreign competition. There are two factors in the economic situation, however, which make it impossible to carry out this policy of selling goods abroad without buying anything in return. In the first place, there is a great over-production of certain things for which markets must be found abroad, and again there are many new engineering and other industries which cannot be carried on satisfactorily unless the production is increased to bring down costs, and that would leave a surplus for export. That would mean the selling of manufactured goods abroad at low prices in order that French makers could keep their own market. The interest of the Franco-German treaty lies in the fact that it demonstrates the failure of this policy. Although the full details of the agreement are not yet publicly known, it is evident that the French have fought hard to secure advantages in the way of sending produce to Germany and in obtaining cheap raw material, while they have endeavoured to exclude German manufactured goods as much as possible. It is now made abundantly clear that a country will not buy unless it can sell, and Germany has only consented to admit French produce, and provide an outlet for the products of Alsace-Lorraine, on condition that it is accorded the most favoured nation treatment with minimum tariffs on the bulk of engineering, chemical, and other products imported into France. A curious feature about this arrangement is the fixing of a scale of import duties on German goods independently of the Tariff Bill. As that measure could not be passed in time the Government was authorised to modify the existing tariffs during the negotiations with Germany if it were found necessary to do so, and these duties will be embodied in a decree which must be signed in time to allow of the agreement coming into force on September 6th. This really means that the new tariff, which has been elaborated during the German negotiations, will form the basis of the Bill when it comes up for debate, and it will be difficult to modify it to any appreciable extent, because that would give Germany an excuse for cancelling the agreement, which the French have obviously every reason to avoid.

German Machinery.

The main object in carrying through the long and laborious negotiations with Germany was to secure special advantages for the agricultural industry. That has dominated everything, and the mechanical industries are already complaining that their interests have been sacrificed, although nothing is yet known of the nature of the import duties on machinery and other manufactured goods beyond the fact that Germany can now export into France under the most favoured conditions. So far as iron and steel are concerned there can be no change in the situation, since the production and sales of these products are governed, to some extent, by international agreements. In the case of machinery, however, the French market is now entirely open to German manufacturers, who enjoy the same privileges as the British, if they can be called privileges when the currency disabilities render it difficult for most foreign machinery makers to do business in this country; but French makers nevertheless fear that the special methods employed in Germany for facilitating an export trade will result in severe competition, especially with agricultural machines. The only sure thing is that the next few months will enable the French to see whether the new experiment is successful or not, and, if the agricultural interest is satisfied with the result, there is no doubt that the new Tariff Bill will be modified in consequence, and that other commercial treaties will be entered into under conditions that may be favourable to a development of foreign trade relations.

Engineering Trades.

The efforts that are being made to prove by statistics that the economic situation is not so bad as is represented, and that a recovery may be looked forward to with an official stabilisation of the franc, do not impress manufacturers who affirm that the crisis is becoming more serious, with a rapidly dwindling hope of possible improvement during the next few months. In nearly all branches of the engineering trades the situation has become precarious. After the spurt in wagon building the railway companies have ceased to give out orders, and while builders have work in hand they fear that nothing will be forthcoming to replace the orders being executed. The contracts for locomotives are of far less importance than had been expected. In shipbuilding there is less being done, although further contracts are being given out under the programme of naval construction, but private orders are becoming scarcer on account of the competition of foreign shipyards. A few motor tankers and other vessels are under construction. Some of the colliery companies intend to utilise the inland waterways more largely for the transport of coal, and are purchasing steel barges. One of the reasons for the dullness of the engineering industries is the quantity of material being obtained from Germany on account of reparation. As this represents so much profit to the State every effort is being made to secure as much as possible from Germany for the carrying out of public works. It is argued that if Germany did not supply the material the State would certainly not be in a position to purchase from home firms. It may be remarked that the statistics published are often incomprehensible. It is shown, for example, that during the first six months of the year 505 tons of machine tools were exported to Great Britain, while no machine tools at all are given as having been imported from that country.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

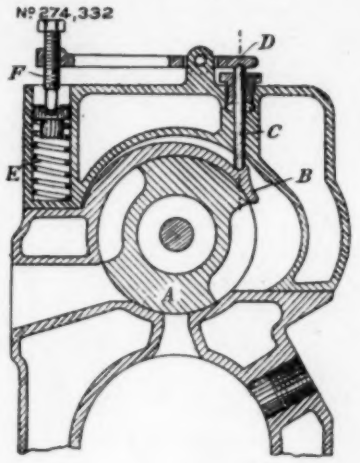
Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

INTERNAL COMBUSTION ENGINES.

274,332. November 10th, 1926.—ROTARY VALVES, E. M. Bournonville, 61, Boorsam-avenue, Jersey City, New Jersey.

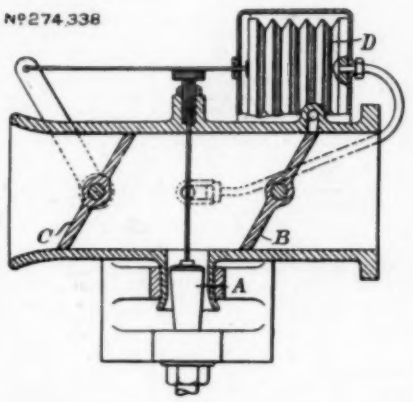
This invention is concerned with engines in which the cycle is controlled by means of a rotary valve above the cylinder head, much after the fashion of a Corliss steam engine. The valve,



shown at A, need not be described, but it is peculiar in that it revolves in a seating of which the upper part B is more or less flexible. This part of the seating is held down to its work by the push rod C, the lever D and the spring E acting in conjunction with the adjusting screw F.—*July 21st*, 1927.

274,338. November 25th, 1926.—CARBURETTERS, G. F. Hunter, 87, High-street, Clapham, S.W. 4.

With this carburetter the amount of air admitted to the engine increases in proportion to the speed of the engine. The combustible mixture is provided by the device indicated at A and its

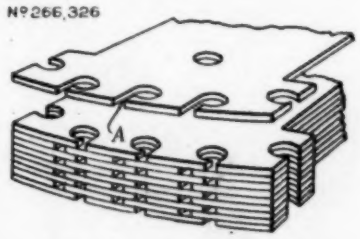


amount is controlled by the normal throttle B. Outside this throttle there is another throttle C, which may be opened to admit an increased supply of air. The position of the second throttle is so controlled by the bellows D that it opens in consonance with the speed of the engine.—*July 21st*, 1927.

DYNAMOS AND MOTORS.

266,326. February 5th, 1927.—IMPROVEMENTS IN AND RELATING TO DYNAMO-ELECTRIC MACHINES, *The British Thomson-Houston Company, Ltd., of Crown House, Aldwych, London, W.C. 2.*

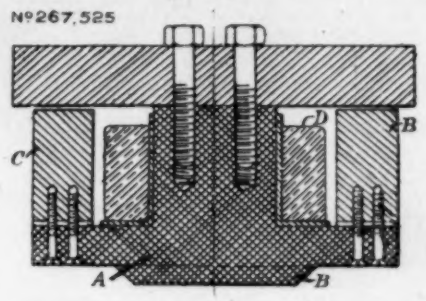
A stator core structure is formed in accordance with this invention of a series of laminations, with the slot openings displaced to one side of the centre line of the slots. Certain laminations are reversed with respect to the others, with the



result that the slot openings of the various laminations forming the complete core present a staggered appearance and overlap, thereby giving, to a certain extent, a closed slot effect. While the invention is applicable to a large variety of dynamo-electric machines, it is shown applied to the field poles of a synchronous motor having squirrel-cage starting winding.—*July 21st*, 1927.

267,525. March 9th, 1927.—IMPROVEMENTS IN AND RELATING TO CONTINUOUS-CURRENT DYNAMO-ELECTRIC MACHINES, *The British Thomson-Houston Company, Ltd., of Crown House, Aldwych, London, W.C. 2.*

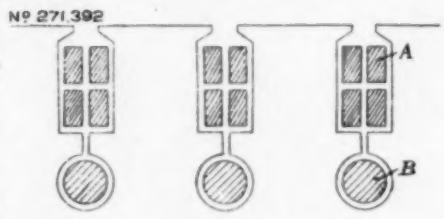
A continuous-current dynamo constructed in accordance with this invention is provided with commutating poles with magnetic breakage paths to reduce the voltage and current variations. The central core A has a projection B, which covers the commutation zone in the ordinary way. The core A has



one or more windings, and is provided with additional magnetic circuits B and C. The coil D is connected in series with the armature in the usual way. The two magnetic circuits B and C are designed to give inductance so that the flow of alternating current which may be superposed in the event of pulsations or abrupt load variations is retarded. There are five other illustrations.—*July 21st*, 1927.

271,392. July 14th, 1926.—POLYPHASE ASYNCHRONOUS MOTOR WITH HIGH STARTING TORQUE, *Ateliers de Constructions Electriques de Charleroi, of 91, Rue de l'Enseignement, Brussels.*.

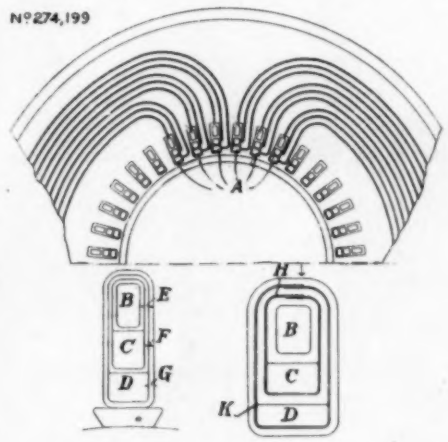
Many schemes have been devised for increasing the starting torque of polyphase induction motors, and the present invention relates to an improved scheme of this kind. The object is to obtain a high starting torque and a progressive speeding up without sudden rushes of current, whilst avoiding the lowering of the power factor under normal running conditions. The rotor has two windings. There is an outer winding A of low reactance, the resistance of which can be modified by any suitable means during the starting period, it being made high when the switch is closed. The inner winding B is of relatively high reactance, and its resistance may be constant. The resistance



will be greater than that of the winding A during normal running, but less than the resistance of the circuit A at the time of starting the motor. The high resistance of the outer winding A at the moment the switch is closed gives a very high starting torque. When the motor attains a certain speed, the device for controlling the resistance of the winding A reduces the resistance, either suddenly or by successive steps, down to the low value corresponding to normal running, the resultant impedance of the rotor being thus reduced and the motor assumes its working speed. The scheme is, of course, a modification of that devised by Boucherot. Apparently, a centrifugal device is used to vary the resistance of the winding A, and it would be interesting to know what advantage this scheme offers over a slip-ring motor from the point of view of cost.—*July 21st*, 1927.

274,199. April 16th, 1926.—IMPROVEMENTS IN AND RELATING TO DYNAMO-ELECTRIC MACHINES AND OTHER ELECTRICAL APPARATUS HAVING SLOTS CONTAINING CONDUCTORS, The Hon. Sir Charles Algernon Parsons, K.C.B., Jessell Rosen, and William Douglass Horsley, all of Heaton Works, Newcastle-on-Tyne.

In high-voltage generators, &c., difficulties arise in keeping down the bulk of the apparatus, and the main object of this invention is to provide arrangements which will assist in over-



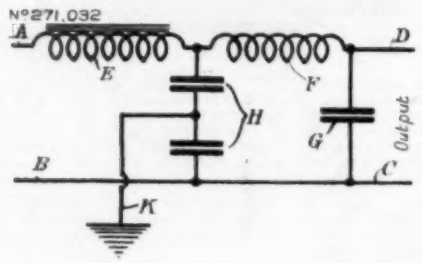
coming these difficulties. The core slots of generators constructed in accordance with this invention contain conductors at different voltages, additional insulation being provided for the higher voltage conductors. In the drawing, six slots associated with the generation of one phase are lettered A. Each slot contains three rectangular conductors B, C and D, connected in series and arranged side by side. The conductor B at the highest voltage is at the bottom of the slot, the conductor C at the medium voltage is the middle of the slot, and the lowest voltage conductor D at the top of the slot. In order to make the best use of the available cross-sectional area of each slot, the high voltage conductor B is of such a shape as to allow for the provision of the required thickness of E of insu-

lation around it, the next conductor C being of the same cross-sectional area, but wider, so that it is stepped in relation to the high voltage conductor B, and has less thickness of insulation F, whilst, finally, the low-voltage conductor D, which also has the same area, is also wider than the medium voltage conductor, which is stepped so that its insulation G is thinnest. In accordance with another feature of the invention, conducting sheaths may be provided for equalising the potential drop across the slot insulation. The sheath H connected with the conductor C is U-shaped, the ends being lapped over to enclose the adjacent high-voltage conductor B, and similarly with respect to the sheath K connected with the conductor D.—*July 18th*, 1927.

TELEGRAPHS AND TELEPHONES.

271,032. December 13th, 1926.—Improvement in Electrical Filters, *Dubilier Condenser Company* (1925), *Ltd.*, *of Ducon Works, Victoria-road, North Acton, London, W.* 3.

By means of the electrical filter described in this specification, oscillations of radio frequency in electrical circuits connected, for example, to a radio receiving set, are avoided. In the diagram the input terminals are shown at A and B, while the output

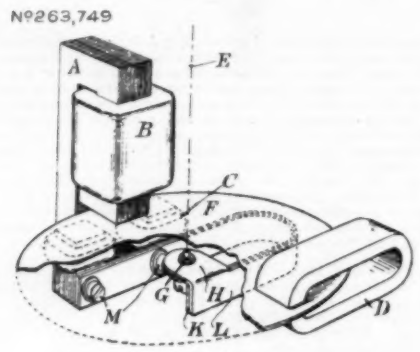


terminals are indicated at D and C. E is a coil with an iron core in series with a radio frequency choke F. Between the conductors D and C there is a condenser G, whilst between the two coils E and F there are condensers H in series. A common terminal earths these condensers, as shown at K. All impulses of radio frequency are conducted away to earth.—*July 21st*, 1927.

MEASURING AND TESTING INSTRUMENTS.

263,749. October 8th, 1926.—Device for Improving the Temperature Coefficient of Electricity Meters, Landis and Gyr S.A., of Zug, Switzerland.

The object of this invention is to improve the temperature coefficient of electricity meters. The electrical element A carries a shunt coil B and two series coils C. D is the brake magnet, and E the shaft, which carries the rotating disc F. The footstep bearing G of the shaft is mounted on the lugs H of a U-shaped compound strip composed of two strips K and L, secured on one side to the electrical element A by means of screws M. The strips K and L are intimately connected along

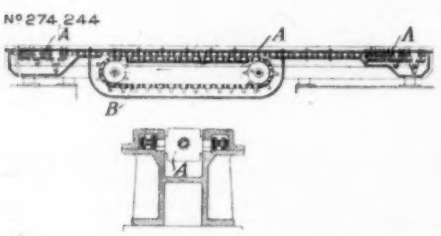


their entire length. The strip K consists of a metal with as low a temperature coefficient as possible, whilst L is formed with a metal having a high temperature coefficient, so that the two form a strip that is sensitive to temperature. At normal temperatures the footstep bearing is in its normal position, but if the temperature rises the footstep bearing is displaced towards the element A, so that the radius on which the brake acts on the disc increases and the increase of the braking movement thus produced counteracts the more rapid running of the disc caused by heat.—*July 21st*, 1927.

MACHINE TOOLS AND SHOP APPLIANCES.

274,244. March 1st, 1927.—The Manufacture of Metal Tubes, The Wellman Seaver Rolling Mill Company, Ltd., and S. Smith, Victoria Station House, Westminster.

The inventors propose to make tubes by drawing a succession of die plates over a billet pierced, but closed at one end, supported on a mandrel. The die plates A A are fixed on two chains running along the sides of the draw bench. These chains are

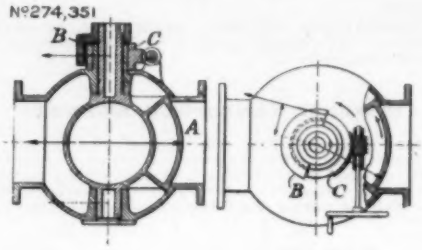


propelled by other endless chains B, having projecting teeth. The arrangement is such that the die plates pack closely together at either end of the machine, while they are properly spaced during the actual drawing process. As a consequence, the overall length of the machine is naturally reduced.—*July 21st*, 1927.

MISCELLANEOUS.

274,351. December 30th, 1926.—Rotary Valves for Pipe Lines, H. Wade, 111, Hatton-garden, London, E.C. 1.

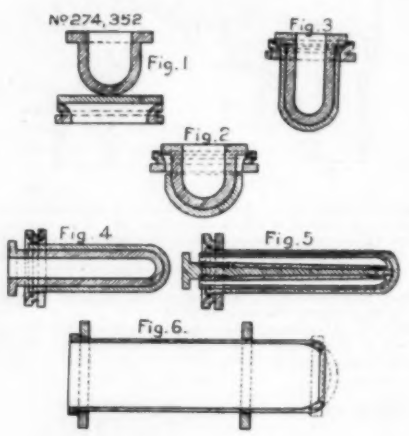
This valve is of the plug type, and the aim of the invention is to relieve the pressure of the plug on its seating when it is rotated for opening. To this end the plug A is mounted on trunnions which are an easy fit in their bearings. On the top of the upper



trunnion there is keyed a segmental shaped piece B, which abuts against stops on a worm wheel C. This worm wheel is actuated by a worm and hand wheel. In the process of opening the pressure of the stop against the segment first pushes the plug off its seating, against the water pressure, and then rotates it to the open position.—*July 21st*, 1927.

274,352. December 31st, 1926.—The Manufacture of Extra High-pressure Conduits, J. Grossweischede, 18, Neustadtstrasse, and G. Reichenbecher, 9, Arndstrasse, Mülheim-Ruhr, Germany.

This invention is concerned with the manufacture of pipes for very high pressures. They are made by pressing a plate through a series of gradually decreasing dies, by rams or mandrels of correspondingly decreasing diameters. The mandrels used in



the later passes are collapsible, so that they may be easily withdrawn. At the last pass the tube is not pushed right through the die—as shown at Fig. 5. Two jointing rings are then threaded on to the pipe—Fig. 6—the closed end is cut open, and the metal is forged outwards to provide a flange at that end.—*July 21st*, 1927.

LAUNCHES AND TRIAL TRIPS.

Portwey, twin-screw tug; built by Harland and Wolff, Ltd.; to the order of the Portland and Weymouth Coaling Company, Ltd.; dimensions, 80ft. by 18ft. by 9ft.; 90 gross tonnage. Engines, twin set of compound, 11in. and 22in., with 15in. stroke; constructed by the builders; launch, August 10th.

Paez, oil tank steamer; built by Palmers Shipbuilding and Iron Company., Ltd.; to the order of the Venezuela Gulf Oil Company. Engines, constructed by MacColl and Pollock, Ltd.; constructed on the Isherwood system of longitudinal framing; launch, August 12th.

Luminetta, oil tank steamer; built by Palmers Shipbuilding and Iron Company, Ltd.; to the order of the Astrakhan Steamship Company, Ltd.; 9000 tons deadweight. Engines, triple-expansion; constructed by the builders; launch August 15th.

Teakwood, oil tank steamer; built by Sir W. G. Armstrong, Whitworth and Co., Ltd.; to the order of the Teakwood Steamship Co. (1926), Ltd.; dimensions, 415ft. by 54ft. 6in. by 31ft. 6in. Engines, triple-expansion, 27in., 45in. and 75in. diameter by 48in. stroke, pressure 180 lb.; constructed by the Wallsend Slipway and Engineering Company, Ltd.; trial trip, August 15th.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

The British Perlit Iron Company, Ltd., of 15, Victoria-street, London, S.W. 1, asks us to announce that it has acquired the British and colonial patent rights in the Thyssen Emmel process, as covered by Patent No. 244,405 of 1924, which it proposes to exploit in this country in conjunction with the Perlit iron process, by selling inclusive licences.

James Pollock, Sons and Co., Ltd., of 3, Lloyd's-avenue, London, E.C. 3, ask us to announce that a company has been formed under the name of the British Star Contra Propeller and Rudder Company, Ltd., which is under its management, and the registered offices of which are at the same address, and which will have world-wide control of the Star Contra propeller and of Star Contra rudder patents.

James Gordon and Co., Ltd., of Windsor House, Kingsway, ask us to announce that they have taken over the complete patent rights for the British Empire, except Canada, and also for all other European countries and their colonies, of (*a*) the Hagan patented automatic regulation for combustion, boilerhouses, &c.; (*b*) the Hall patented system of boiler water conditioning; and (*c*) the Hagan patented steam separator; and that the new Hagan department is under the management of Mr. J. E. O'Breen.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

WEDNESDAY TO WEDNESDAY, AUGUST 31st TO SEPTEMBER 7th.

British Association for the Advancement of Science.—Meetings at Leeds.

TUESDAY TO FRIDAY, SEPTEMBER 6th TO 9th.

The Institute of Metals.—Annual meeting at Derby. For programme see page 148.

THURSDAY TO SATURDAY, SEPTEMBER 8th TO 24th.

Shipping, Engineering and Machinery Exhibition.—Olympia, London, W. 6.

CONTRACTS.

The Westinghouse Brake and Saxby Signal Company, Ltd., has received an order from the English Electric Company, Ltd., of Preston, for twenty-five sets of brake apparatus for motor cars and twenty-three sets of brake equipment for trailer cars on the Athens City tramways. The same company has also received an order from the Metropolitan-Vickers Electrical Company, Ltd., for 105 motor-driven air compressors, type D.H.25, for motor coaches for the Sydney suburban electrification.

The Marconi International Marine Communication Company, Ltd., has received orders for fitting over 200 ships with the new Marconi auto alarm apparatus, among the shipowners who have placed orders being the Royal Mail Steam Packet Company, T. and J. Brocklebank, F. C. Strick and Co., Ltd., Elders and Fyffes, Ltd., the Glen Line Services, the Sun Shipping Company, Ltd., Lambert Brothers, Ltd., Ellerman Lines, Clan Line, Andrew Weir and Co., and T. and J. Harrison.

William Beardmore and Co., Ltd., have been employed for some time past at their Mossend (Lanarkshire) rolling mills on the fulfilment of the following orders from abroad:—(*a*) For over 7150 tons of rails, fishplates and other accessories for the Government of Esthonia; (*b*) for 1800 tons of 60 lb. F.B. rails, to be laid on the Eastern Bengal section of the Indian State Railways; (*c*) for 300 tons of rails for trial on the Chilian State Railways; and (*d*) for 2038 tons of rails in 60 lb. F.B. section, also 480 tons of fishplates for rails of 50 lb. and 60 lb. sections, a total weight of 2518 tons, from the South Indian Railway Company, Ltd.

CATALOGUES.

Henry Simon, Ltd., Mount-street, Manchester.—Catalogue on pneumatic and mechanical coal and ash-handling plant.

Head, Wrightson and Co., Ltd., Stockton Forge, Norton-road, Stockton-on-Tees.—Booklet on chimneys and tanks.

Alfred Herbert, Ltd., Coventry.—Booklet entitled "Coventry Die Heads and Wickman Gauges—Appreciations."

The Wellman Bibby Company, Ltd., Victoria Station House, Victoria-street, S.W. 1.—Booklet F.2 on "Filtration of Gas and Air."

James and Fredk. Howard, Ltd., Bedford.—Catalogue 1601, Howard's all-British road graders and other roadmaking equipment.

James Archdale and Co., Ltd., Ledsam-street, Birmingham.—List V.M.I., describing the "Archdale" 30in. vertical milling machine.

Birmingham Small Arms Company, Ltd., Birmingham.—Catalogue of B.S.A. taps, dies and screwing sets manufactured by B.S.A. Tools, Ltd.

British Insulated Cables, Ltd., Prescot, Lancs.—P212, armoured cables and accessories (replacing P178); P217, aluminium matting and sections (replacing P180).

Westinghouse Brake and Saxby Signal Company, Ltd., 82, York-road, King's Cross, N.1.—Publication M2007 on electro pneumatic decking plant at Harworth Colliery.

William Alexander, 167, St. Vincent-street, Glasgow.—Particulars of the "Supreme" vortex separator for removing solid and liquid impurities from air, gas and steam.

Rees Roturbo Manufacturing Company, Ltd., Wolverhampton.—Pamphlet R.239, describing the "Non-clog" pump for unscreened sewage, solids, paper pulp, rags, stones, &c.

The Cambridge Instrument Company, Ltd., 45, Grosvenor-place, S.W. 1.—List No. 151, dealing with the Thomas recording gas meter, illustrating typical installations at home and abroad.

Mather and Platt, Ltd., Park Works, Manchester.—A joint publication of the firm and A. Reyrolle and Co., Ltd., dealing in detail with automatic rotary converter sub-station service.

W. H. Willcox and Co., Ltd., 38, Southwark-street, S.E. 1.—Engineers' stores, boiler mountings, pumps, hose, tools, lubricants, catalogue in two sections. A third section is in course of preparation.

The "Sentinel" Waggon Works, Ltd., Iddesleigh House, Caxton-street, S.W. 1.—Catalogue of locomotives, including not only those of standard railway type, but sections containing abridged catalogues of industrial type locomotive and also of the "Sentinel-Cammell" steam rail coaches.

Guest and Chrimes, Ltd., Rotherham.—The firm's general catalogue—a bound volume of 266 pages, sectionalised under the following headings:—Water meters; sluice valves; reservoir fittings; recorders, indicators and gauges; penstocks; hydrants; fire fittings; water pillars; pipes and pipe fittings; cocks and brass fittings.

Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa.—The following pamphlets have been received:—Type C magnetic starters for direct-current motors; the electric power shovel; permissible type motors and control for use in gaseous mines; synchronous motors for centrifugal pump drive; Class 11-000 magnetic starters for squirrel-cage induction motors; safety coils for indoor and outdoor service on series alternating-current circuits; distribution transformers for industrial applications; 24in. floodlight projector; main drive motor equipments for rolling mill service.